BERICHTE
aus dem Fachbereich Geowissenschaften der Universität Bremen

No. 259

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REPORT AND PRELIMINARY RESULTS OF POSEIDON CRUISE 344, LEG 1 AND LEG 2 LAS PALMAS (SPAIN) – LAS PALMAS (SPAIN) Oct. 20th – Nov. 2nd & Nov. 4th- Nov. 13th, 2006

Berichte, Fachbereich Geowissenschaften, Universität Bremen, No. 259,
47 Seiten, Bremen 2008

ISSN 0931-0800

The „Berichte aus dem Fachbereich Geowissenschaften“ are produced at irregular intervals by the Department of Geosciences, Bremen University.
They serve for the publication of experimental works, Ph.D.-theses and scientific contributions made by members of the department.

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Citation:
Fischer, G., Ruhland, G. and participants
Report and preliminary results of Poseidon cruise 344, Leg 1 & Leg 2, Las Palmas – Las Palmas, 20.10.2006.-02.11.2006 & 04.11.2006 – 13.11.2006
Berichte, Fachbereich Geowissenschaften, Universität Bremen, No. 259, 47 pages, Bremen, 2008.

ISSN 0931-0800

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1. Participants

Leg 1

Name	Domain	Institution
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Daberkow, Timo	Marine Chemistry	UBMCh
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Hamoumi, Naima	Observer	Univ. Rabat
Iversen, Morten Hvitfeldt	Marine Biology	MPI / AWI
Klann, Marco	Technician	RCOM
Kodrans-Nsiah, Monika	Micropalaeontology	GeoB
Nowald, Nicolas	Marine Geology / Technology	RCOM
Reuter, Christian	Technician	GeoB
Stolz, Katharina	Sedimentology	GeoB

GeoB: FB5 Geosciences, Univ. Bremen
MPI: Max Planck Insitution for Marine Microbiology
AWI: Alfred Wegener Institute for Polar and Marine Research
UBMCh: FB2, Marine Chemnistry, Univ. Bremen
RCOM:Research Center Ocean Margins

Leg 2

Name	Domain	Institution
Ruhland, Götz	Chief scientist	MARUM
Bosch, Macarena	Marine Chemistry	ICCM
Cianca, Andres	Marine Chemistry	ICCM
Dehning, Klaus	Technician	MARUM
Kalweit, Holger	Technician	MARUM
Kuhlmann, Dennis-Pascal	Student	MARUM
Llerandi, Carolina	Marine Chemistry	ICCM
Rehage, Ralf	Technician	RCOM
Rodriguez, Ivan	Marine Chemistry	ICCM

ICCM: Instituto Canario de Ciencias Marinas
MARUM: Marum, Center for Environmental Research, Univ. Bremen
RCOM:Research Center Ocean Margins

LEG 1

2. Narrative

RV Poseidon left the port of Las Palmas (Gran Canaria) on October, 20, 2006 at 10:30 pm sailing in southwesterly direction to the study area off Cape Blanc (Mauretania). It was planned to perform marine-chemical, microbial and micropaleontological studies off Cape Blanc as well as the exchange of two sediment trap moorings which were deployed during RV METEOR cruise the year before. Additionally, a particle camera was planned to be launched to measure the distribution and size of marine snow aggregates. A small ROV *Cherokee* was scheduled to be launched for the observation and sampling of these larger particles.

On Sunday, 22th of October, we reached the first study site at about 21°17.N/20°49.W. Here we recovered the sediment trap mooring CB-16 within two hours; all instruments had worked well. The study site is located at the edge of the coastal upwelling filament off Cape Blanc (Mauretania). After recovery, the new mooring was prepared for deployment and the Kevlar wire for marine-chemical studies was put on the winch. After launching the rosette with the SBE19-CTD (equipped with oxygen and chlorophyll sensors), the GoFlo water casts attached to the Kevlar wire were launched to 800m water depth. On early monday morning the 23th of October, the particle camera attached with the SBE 19-CTD was deployed during darkness. The new sediment trap mooring CB–17 was redeployed on the former position of CB-16 during a short time period. The ROV *Cherokee* was tested, followed by two sets of rosettes (equipped with the Kiel-CTD SBE 11) and GoFlo casts to 750 water depth.

We then sailed to the east to study site two at about 21°N/20°W which we reached on Tuesday morning. After the deployment of the particle camera ParCa with the SBE 19-CTD to 2000m water depth and the collection of water casts from the rosette we terminated this site and sailed further to the east. In the evening, the particle camera with CTD was launched at this site number three. The following morning, three sets of rosette casts together with 8 GoFlo casts were deployed. On Wednesday, we moved further to the east to reach the mooring site CBi-3/4. There, we deployed the particle camera in the evening and in the early morning due a detection of a deep particle maximum. Lateron, the sediment trap mooring CBi-3 was completely recovered, whereby only the upper sediment trap had worked perfectly. We then launched three rosette casts to 40, 15 and 2400m water depth. In the evening, a third particle profile was obtained with ParCa to observe a potential sinking of a particle cloud in about 2000 m water depth. On Friday morning, the new sediment trap mooring CBi-4 was deployed successfully, although swell was rather high.

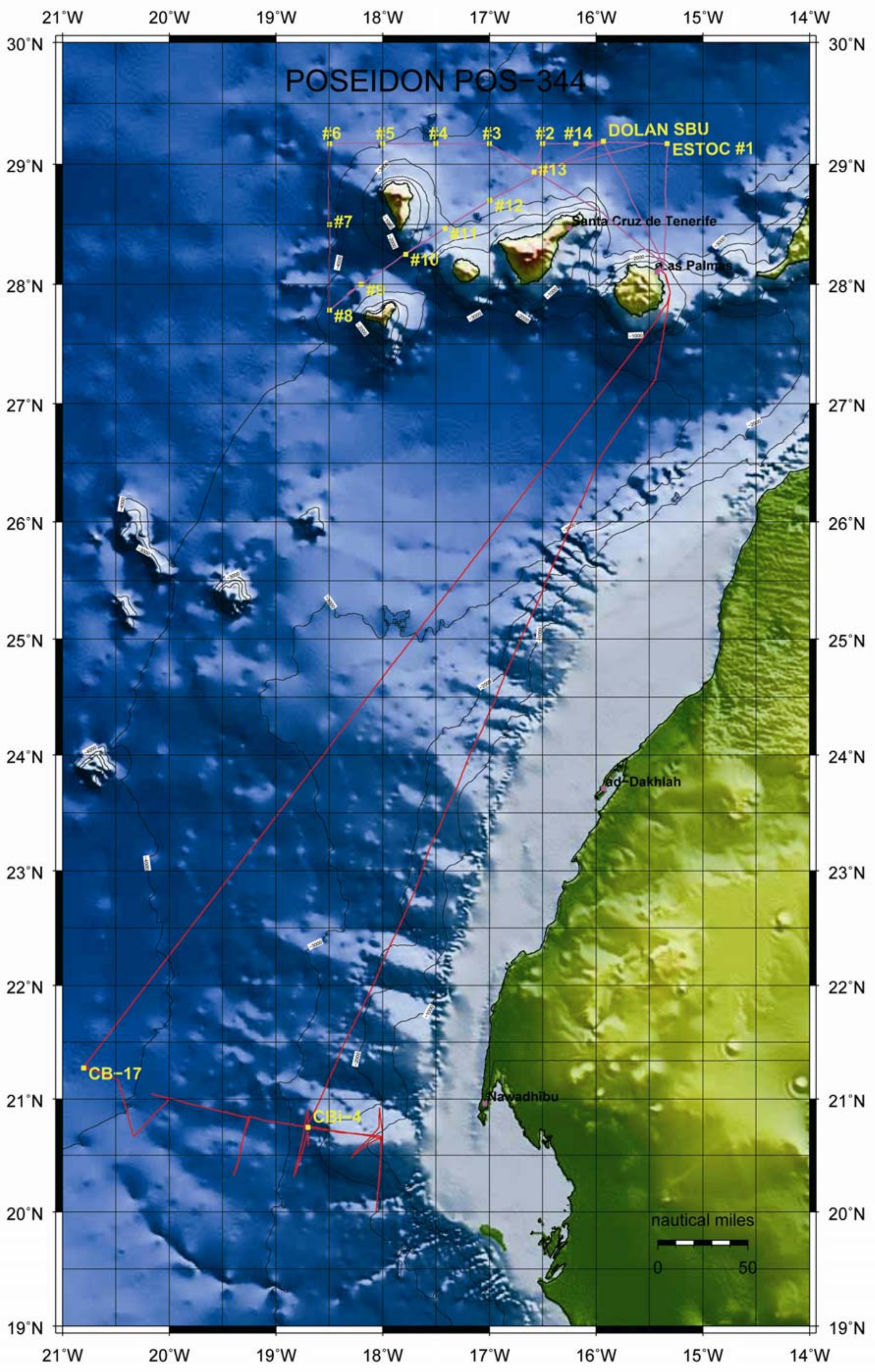


Fig. 1: Course map of RV Poseidon cruise 344, leg 1 and leg2

We arrived at the fifth study site on late Friday evening, October, 27th. The scheduled launching of the particle camera down to 850m depth was delayed due to unfavourable weather conditions; the particle data revealed a maximum in about 60 m water depth. Due to strong surface currents, we could not launch the ROV to observe and sample larger particles. We therefore sailed further to the south to study site 6 at 19°45.N/18°05.W. We deployed the particle camera and one set of rosette samples were taken. During the day, we ran into problems with the ships' compass system and the crew had to move the ship by hand using the magnetic compass. During the night we sailed back to site 5 for the deployment of the ROV *Cherokee*. However, this was impossible due to strong currents and the navigational problems. We moved about 35 nm to the west for the mooring site CBi-3/4 where less swell and lower surface currents prevailed to allow the deployment of the ROV *Cherokee* for almost 3 hours. All station work was then finished with a last camera launch and at 19:00 a.m. FS POSEIDON started to cruise back to Las Palmas. We arrived there on late Tuesday evening, October, 31.

3. Preliminary Results

3.1. Marine Chemistry

3.1.1. Scavenged-type trace metals in solution and colloids (colloidal particles) off Cape Blanc

(Timo Daberkow)

Particle-water interaction is a key process in the biogeochemical cycling of chemical elements in the ocean. Uptake into/onto particulate matter and subsequent sinking (scavenging) exerts major control on the chemical composition of seawater. This process maintains the rather low concentrations of many elements in seawater. Marine Particles can be classified into different size fractions: (i) there are relatively large/heavy, fast sinking particles, which are responsible for the vertical transport towards the sediment; most of the mass resides (ii) in small, almost unsinkable suspended particulate matter (SPM) of biogenic and terrestrial origin; and (iii) the colloidal fraction which passes the filter membranes (< 0.4 µm) which are typically used to separate the SPM from the dissolved fraction. Thus, the fraction classically regarded as dissolved, needs to be divided into the colloidal fraction(s) and the "truly" dissolved fraction. The role of this colloidal fraction in the interactions between dissolved and particulate matter in the ocean and its trace element composition is still widely unknown. Although being part of the operationally defined dissolved fraction, the colloidal size fraction including the elements adsorbed on the colloids may have biogeochemical properties different from those of "truly" dissolved elements.

The comparison of trace element composition of the different fractions in seawater (dissolved, colloidal and "truly" dissolved) are expected to provide important clues on the transport and sorption mechanisms, especially sorption of trace elements onto colloids, as well as on the general biogeochemical behavior of the analyzed trace elements (e.g. Fe, Co, Ni, Cu, Zn, Cd, Pb) in the ocean. With Fe being a prominent example, many of the trace element studied here are essential for marine life, and thus also for the biogenically induced particle flux within the water column. These trace elements cover a broad range of chemical properties, enabling the study of relevant biogeochemical processes in greater detail.

During the cruise P 344-1 water samples from four different stations were collected for the analysis of different trace elements in the mentioned fractions (for details on samples, see Table 1). Dissolved samples have been separated into "truly" dissolved and colloidal sample material using cross-flow ultra filtration (CFUF, with nominal mass cut-offs at 30000, 10000, 5000, and 3000 Da).

Table 1: Water sampling for trace element analysis.

Station GeoB no.	Depths in m	Volume in l	Remarks
11401-2	200	3.5 each	UnF, UF, TM
11401-4	100, 150	3.5 each	UnF, UF, TM
11401-10	25, 50, 250, 300, 400, 500, 600, 750	3.5 each	UnF, UF, TM
11403-5	25, 100, 200, 300, 400, 500, 600, 750	3.5 each	UnF, UF, TM
11405-4	20, 70, 100, 200, 250, 350, 600, 697	1 each	UnF, TM
11406-2	15, 30, 50, 100, 150, 200	1 each	UnF, TM

UnF: unfiltered sample; UF: ultra filtration as described in text; TM: analysis for trace metals as described in text

3.2. Marine Microbiology

3.2.1 Carbon turnover in sinking particles *(Morten Iversen)*

The main objective of the study on this cruise was to investigate the carbon turnover in sinking particles in the waters off Cape Blanc. The investigations were focussed on marine snow (organic aggregates >500µm) and particulate organic carbon (POC). This was performed by produced aggregates in roller tanks using *in situ* water. Further carbon concentration profiles were made at three stations (Table 2). The bacterial degradation and settling velocity of the aggregates were measured versus their sizes.

Table 2: Water sampling for microbiological studies.

Stations GeoB no.	Depths in m (always 10 l water used)	Working procedure
11401	50	Formation of aggregates in roller tanks. Size, settling, and respiration measured.
11402	-	-
11403	10, 50, 60, 75, 150, 200, 250, 300, 500, and 800	Formation of aggregates in roller tanks. Size, settling, and respiration measured. Oxygen concentration profile with Winkler.
11404	40, 600, 1200, 1700, 1900, and 2400	Formation of aggregates in roller tanks. Size, settling, and respiration measured. Carbon concentration profile.
11405	20, 75, 250, 600, and 700	Formation of aggregates in roller tanks. Size, settling, and respiration measured. Carbon concentration profile.
11406	15, 30, 50, 100, and 200	Carbon concentration profile.

3.3. Marine Micropaleontology

3.3.1. Dinoflagellate studies *(Monika Kodrans-Nsiah)*

1) Preservation experiment samples fixed to the sediment trap CB-16 (upper and lower) were exchanged and fixed to the sediment trap CB-17 to be moored at the same location for another year. Retrieved samples will be analyzed for organic-walled dinoflagellates.

2) CTD profiles and rosette water-samples were taken at 6 stations; most of them within upper water column (up to 200m depth) but some went as deep as 2000m.

3) The overall number of 30 water-samples of initial volume 20 L was collected using the rosette equipped with a SeaBird-CTD (6 samples at 5 different stations). Water-samples were sieved onboard through 75 µm nylon sieve and filtered through 10 µm nylon filter using vacuum pump. Residue from the filter (75-10 µm) was collected for analysis of calcareous dinoflagellates (i.e. *T. heimii*) and isotopes by washing filter with fresh water resulting in samples of ~100mL final volume. Decent amount (2-4 drops) of ammonia solution (25%) was added to every final sample in order to prevent changing the samples' pH during storage (Table 3)

Table 3: Water sampling from the rosette for dinoflagellate studies.

Sample No.	Date 2006	Time UTC	Latitude	Longitude	Water-depth in m (winch)	Water-depth in m	Initial Vol. in l	Vol.[ml] after filtrat.	Remarks
11401-8 100m	23.10.	13:15	21°16'50"N	20°48'50"W	98	100.46	10	100	Collected fraction: 75-10µm.
11401-8 50m	23.10.	13:18	21°16'50"N	20°48'50"W	48	49.44	20	100	Collected fraction: 75-10µm. Chlorophyll maximum.
11401-8 40m	23.10.	13:19	21°16'50"N	20°48'50"W	39	40.15	20	100	Collected fraction: 75-10µm.
11401-8 30m	23.10.	13:20	21°16'50"N	20°48'50"W	29	29.78	20	100	Collected fraction: 75-10µm.
11401-8 20m	23.10.	13:22	21°16'50"N	20°48'50"W	20	20.94	20	100	Collected fraction: 75-10µm.
11401-8 10m	23.10.	13:23	21°16'50"N	20°48'50"W	10	10.72	20	100	Collected fraction: 75-10µm.
11402-2 50m	24.10.	8:10	20°59'59"N	19°59'59"W	55	51.80	20	100	Collected fraction: 75-10µm.
11402-2 45m	24.10.	8:12	20°59'59"N	19°59'59"W	47	44.40	20	100	Collected fraction: 75-10µm. Chlorophyll maximum.
11402-2 40m	24.10.	8:15	20°59'59"N	19°59'59"W	44	40.19	20	100	Collected fraction: 75-10µm.
11402-2 30m	24.10.	8:17	20°59'59"N	19°59'59"W	34	30.31	20	100	Collected fraction: 75-10µm.
11402-2 20m	24.10.	8:19	20°59'59"N	19°59'59"W	24	20.37	20	100	Collected fraction: 75-10µm.
11402-2 10m	24.10.	8:20	20°59'59"N	19°59'59"W	14	10.40	20	100	Collected fraction: 75-10µm.
11403-2 60m	25.10.	8:12	20°14'05"N	19°14'55"W	60	60.91	20	100	Collected fraction: 75-10µm.
11403-2 50m	25.10.	8:14	20°14'05"N	19°14'55"W	50	50.04	20	100	Collected fraction: 75-10µm. Chlorophyll maximum.
11403-2 40m	25.10.	8:15	20°14'05"N	19°14'55"W	40	40.20	20	100	Collected fraction: 75-10µm.
11403-2 30m	25.10.	8:16	20°14'05"N	19°14'55"W	30	30.08	20	100	Collected fraction: 75-10µm.
11403-2 20m	25.10.	8:17	20°14'05"N	19°14'55"W	20	20.49	20	100	Collected fraction: 75-10µm.
11403-2 10m	25.10.	8:18	20°14'05"N	19°14'55"W	10	10.28	20	100	Collected fraction: 75-10µm.
11404-4 40m	26.10.	12:12	20°45'20"N	18°42'15"W	40	42.25	20	100	Collected fraction: 75-10µm.
11404-4 30m	26.10.	12:14	20°45'20"N	18°42'15"W	30	31.31	10	100	Collected fraction: 75-10µm.
11404-4 25m	26.10.	12:17	20°45'20"N	18°42'15"W	25	25.01	20	100	Collected fraction: 75-10µm. Chlorophyll maximum.
11404-4 20m	26.10.	12:18	20°45'20"N	18°42'15"W	20	20.01	20	100	Collected fraction: 75-10µm.
11404-4 15m	26.10.	12:20	20°45'20"N	18°42'15"W	15	16.29	20	100	Collected fraction: 75-10µm.
11404-4 10m	26.10.	12:22	20°45'20"N	18°42'15"W	10	10.90	20	100	Collected fraction: 75-10µm.
11405-2 50m	28.10.	8:49	20°39'55"N	18°00'28"W	50	49.96	20	100	Collected fraction: 75-10µm. First chlorophyll maximum.
11405-2 40m	28.10.	8:51	20°39'55"N	18°00'28"W	40	40.81	19	100	Collected fraction: 75-10µm.
11405-2 30m	28.10.	8:52	20°39'55"N	18°00'28"W	30	30.93	20	100	Collected fraction: 75-10µm.
11405-2 25m	28.10.	8:53	20°39'55"N	18°00'28"W	25	25.00	20	100	Collected fraction: 75-10µm.
11405-2 20m	28.10.	8:55	20°39'55"N	18°00'28"W	20	21.22	20	100	Collected fraction: 75-10µm.
11405-2 15m	28.10.	8:56	20°39'55"N	18°00'28"W	15	15.80	20	100	Collected fraction: 75-10µm. Second chlorophyll maximum.

3.3.2. Coccolithophorid studies *(Katharina Stolz)*

Coccolithophores play an important role in the marine food web as they are marine primary producers. The surface of a coccolithophore cell is covered with tiny calcite plates with a complex ornamentation (coccoliths). These coccoliths compose the deep-sea sediments and therefore provide information for the interpretation of geological records. Knowing the ecological and oceanographic characteristics of living species helps understanding and reconstructing the palaeoenvironment. Therefore they are used for palaeoceanographical and palaeoecological studies. For this purpose water samples have been taken during the cruise to study the composition and distribution of coccolithophore assemblages.

At 5 stations water samples have been taken from 6-10 water depths between 10 and 250m. The sample depths were made up depending on the results of the chlorophyll fluorescence analysis (CTD-O_2_chl_f fixed on Particle Camera System). Sampling was conducted with a multi-water sampler (Rosette) with CTD (SBE 11, IfM Kiel). In addition, left over water samples from other samplings were used. Furthermore surface water samples have been taken from an on-board pump to study the spatial distribution of coccolithophores in the research area.

The water samples were each filtered on a 0.45µm filter (diameter 47mm) using a vacuum pump onboard, then stored in plastic petri dishes, and dried for at least 48hours at 40°C. Lateron the samples were packed in foil for the transport, and kept permanently dry with silica gel pellets. The filtered material will be studied by means of a Scanning Electron Microscope. To study the calcareous nannoplankton, especially coccolithophores, the following samples have been taken (Tables 4-10).

Table 4: Rosette water samples for coccolithophore analysis from Station GeoB 11401.

Sample No.	Sample	Date 2006	Latitude (N)	Longitude (W)	Rosette Bottle No.	Water depth (m)	Sample depth (m)	Filter Vol. (l)	Remarks
1	GeoB 11401-10 250m	23.10.	21°16.1	20°46.5	GoFlo	4150	250	4	Sample from GoFlo
2	GeoB 11401-9 200m				1	4151	200	5	CN
3	GeoB 11401-9 200m				1	4151	200	2	PC
4	GeoB 11401-9 125m				3	4151	125	3,5	CN
5	GeoB 11401-9 125m				3	4151	125	3	PC
6	GeoB 11401-9 100m				4	4151	100	3	CN
7	GeoB 11401-9100m				4	4151	100	4	PC
8	GeoB 11401-9 75m				5	4151	75	3	CN
9	GeoB 11401-9 75m				5	4151	75	3	PC
10	GeoB 11401-9 60m				6	4151	60	2,5	CN
11	GeoB 11401-9 60m				6	4151	60	3	PC
12	GeoB 11401-9 50m				9	4151	50	1	CN (Chlorophyll-max.)
13	GeoB 11401-9 50m				9	4151	50	1,5	CN
14	GeoB 11401-9 50m				9	4151	50	2	PC
15	GeoB 11401-9 40m				10	4151	40	1	CN
16	GeoB 11401-9 40m				10	4151	40	1,5	CN
17	GeoB 11401-9 40m				10	4151	40	2	PC
18	GeoB 11401-9 25m				11	4151	25	1,5	CN
19	GeoB 11401-9 25m				11	4151	25	2	PC
20	GeoB 11401-9 10m				12	4151	10	1,5	CN

Table 5: Rosette water samples for coccolithophore analysis from Station GeoB 11402.

Sample No.	Sample	Date 2006	Latitude (N)	Longitude (W)	Rosette Bottle No.	Water depth (m)	Sample depth (m)	Filter Vol. (l)	Remarks
22	GeoB 11402-3 200m	24.10.	20°59.9	19°59.9	1	3802	200	3	CN
23	GeoB 11402-3 200m				1	3802	200	2	PC
24	GeoB 11402-3 150m				2	3802	150	3	CN
25	GeoB 11402-3 150m				2	3802	150	3	PC
26	GeoB 11402-3 100m				3	3802	100	4	CN
27	GeoB 11402-3 100m				3	3802	100	3,5	PC
28	GeoB 11402-3 75m				4	3802	75	3	CN
29	GeoB 11402-3 75m				4	3802	75	2,5	PC
30	GeoB 11402-3 60m				5	3802	60	2	CN
31	GeoB 11402-3 60m				5	3802	60	1,5	PC
32	GeoB 11402-3 50m				6	3802	50	1	CN
33	GeoB 11402-3 50m				6	3802	50	1	PC
34	GeoB 11402-3 45m				9	3802	45	0,5	CN (Chlorophyll-max)
35	GeoB 11402-3 45m				9	3802	45	1	CN
36	GeoB 11402-3 45m				9	3802	45	1	PC
37	GeoB 11402-3 40m				10	3802	40	1	CN
38	GeoB 11402-3 40m				10	3802	40	1	PC
39	GeoB 11402-3 25m				11	3802	25	1	CN
40	GeoB 11402-3 25m				11	3802	25	1	PC
41	GeoB 11402-3 10m				12	3802	10	1,5	CN
42	GeoB 11402-3 10m				12	3802	10	1	PC

Table 6: Rosette water samples for coccolithophore analysis from Station GeoB 11403.

Sample No.	Sample	Date 2006	Latitude (N)	Longitude (W)	Rosette Bottle No.	Water depth (m)	Sample depth (m)	Filter Vol. (l)	Remarks
43	GeoB 11403-4 500m	25.10.	20°50.1	19°14.8	3	3375	500	5	CN; water taken from M.I.
44	GeoB 11403-3 200m				1	3375	200	3,5	CN
45	GeoB 11403-3 150m				2	3375	150	3,5	CN
46	GeoB 11403-3 150m				2	3375	150	3,5	PC
47	GeoB 11403-3 125m				3	3375	125	4	CN
48	GeoB 11403-3 125m				3	3375	125	3,5	PC
49	GeoB 11403-3 100m				4	3375	100	3	CN
50	GeoB 11403-3 100m				4	3375	100	3	PC
51	GeoB 11403-3 75m				10	3375	75	2,5	CN
52	GeoB 11403-3 75m				10	3375	75	2,5	PC
53	GeoB 11403-3 60m	25.10.	20°50.15	19°15.99	8	3375	60	2	CN (Chlorophyll-max.)
54	GeoB 11403-3 60m				8	3375	60	2	PC
55	GeoB 11403-3 50m				9	3375	50	1,5	CN
56	GeoB 11403-3 50m				9	3375	50	1	PC
57	GeoB 11403-3 40m				10	3375	40	1,5	CN
58	GeoB 11403-3 40m				10	3375	40	1,5	PC
59	GeoB 11403-3 25m				11	3375	25	1,5	CN
60	GeoB 11403-3 25m				11	3375	25	1	CN
61	GeoB 11403-4 10m	25.10.	20°50.1	19°14.8	12	3375	10	2	CN; Water taken from M. I.
62	GeoB 11403-3 10m				12	3375	10	3	CN
63	GeoB 11403-3 10m				12	3375	10	1,5	PC

Table 7: Rosette water samples for coccolithophore analysis from Station GeoB 11404.

Sample No.	Sample	Date 2006	Latitude (N)	Longitude (W)	Rosette Bottle No.	Water depth (m)	Sample depth (m)	Filter Vol. (l)	Remarks
64	GeoB 11404-5 125m	26.10.	20°45.39	18°42.23	1	2698	125	2	CN
65	GeoB 11404-5 125m				1	2698	125	2,5	PC
66	GeoB 11404-5 100m				2	2698	100	2,5	CN
67	GeoB 11404-5 100m				2	2698	100	3	PC
68	GeoB 11404-5 75m				3	2698	75	2	CN
69	GeoB 11404-5 75m				3	2698	75	2	PC
70	GeoB 11404-5 60m				4	2698	60	2	CN
71	GeoB 11404-5 60m				4	2698	60	2	PC
72	GeoB 11404-5 50m				5	2698	50	0,5	CN
73	GeoB 11404-5 50m				5	2698	50	0,5	PC
74	GeoB 11404-5 40m				8	2698	40	0,5	CN (Chlorophyll-max.)
75	GeoB 11404-5 40m				8	2698	40	0,7	PC
76	GeoB 11404-5 30m				9	2698	30	0,5	CN
77	GeoB 11404-5 30m				9	2698	30	1	PC
78	GeoB 11404-5 25m				10	2698	25	1	CN
79	GeoB 11404-5 25m				10	2698	25	1	PC
80	GeoB 11404-5 20m				11	2698	20	1	CN
81	GeoB 11404-5 20m				11	2698	20	1	PC
82	GeoB 11404-5 10m				12	2698	10	1	CN
83	GeoB 11404-5 10m				12	2698	10	1	PC

Table 8: Rosette water samples for coccolithophore analysis from Station GeoB 11405.

Sample No.	Sample	Date 2006	Latitude (N)	Longitude (W)	Rosette Bottle No.	Water depth (m)	Sample depth (m)	Filter Vol. (l)	Remarks
84	GeoB 11405-4 200m	28.10.	20°40.2	18°00.3	7	869	200	3	CN; Water taken from M.I. and T. D.
85	GeoB 11405-3 125m				1	861	125	2	CN
86	GeoB 11405-3 125m				1	861	125	3	PC
87	GeoB 11405-3 100m				2	861	100	1,5	CN
88	GeoB 11405-3 100m				2	861	100	1,5	PC
89	GeoB 11405-3 75m				3	861	75	1,5	CN (Chlorophyll-max.)
89	GeoB 11405-3 75m				3	861	75	1	CN
90	GeoB 11405-3 75m				3	861	75	1	PC
91	GeoB 11405-3 60m				6	861	60	1	CN
92	GeoB 11405-3 60m				6	861	60	1,5	PC
93	GeoB 11405-3 50m				7	861	50	1	CN
94	GeoB 11405-3 50m				7	861	50	1,5	PC
95	GeoB 11405-3 40m				8	861	40	1	CN
96	GeoB 11405-3 40m				8	861	40	1	PC
97	GeoB 11405-3 30m				9	861	30	1	CN
98	GeoB 11405-3 30m				9	861	30	1	PC
99	GeoB 11405-3 25m				10	861	25	1	CN
100	GeoB 11405-3 25m				10	861	25	1	PC
101	GeoB 11405-3 20m				11	861	20	1	CN
102	GeoB 11405-3 20m				11	861	20	1	PC
103	GeoB 11405-3 15m				12	861	15	1	CN
104	GeoB 11405-3 15m				12	861	15	1	PC

Table 9: Rosette water samples for coccolithophore analysis from Station GeoB 11406.

Sample No.	Sample	Date 2006	Latitude (N)	Longitude (W)	Rosette. Bottle No.	Water depth (m)	Sample depth (m)	Filter Vol (l)	Remark
105	GeoB 11406-2 200m	28.10.	19°45.0	18°05.1	1	2125	200	3	CN; from M. I.
106	GeoB 11406-2 150m				3	2125	150	2	CN; from M. I.
107	GeoB 11406-2 100m				5	2125	100	2	CN; from M. I.
108	GeoB 11406-2 50m				8	2125	50	1,5	CN; from M. I.
109	GeoB 11406-2 30m				10	2125	30	1,5	CN; from M. I.
110	GeoB 11406-2 15m				11	2125	15	1,5	CN; from M. I.

Table 10: Surface pump water samples for coccolithophore analysis.

Sample No.	Sample	Date 2006	Sampling time (UTC)	Sample depth (m)	Filter Vol. (l)	Remarks
111	21/10/06-12:00	21.10.	12:00	AP	4	CN
112	21/10/06-12:00		12:00	AP	5	CN
113	21/10/06-18:00		18:00	AP	5	CN
114	22/10/06-06:00		06:00	AP	5	CN
115	22/10/06-12:00		12:00	AP	5	CN
116	22/10/06-18:00		18:00	AP	5	CN
117	23/10/06-06:00		06:00	AP	5	CN
118	23/10/06-12:00		12:00	AP	5	CN
119	23/10/06-18:00		18:00	AP	4	CN
120	24/10/06-00:05		00:05	AP	4	CN
121	24/10/06-06:00		06:00	AP	4	CN
122	24/10/06-12:00		12:00	AP	4	CN
123	24/10/06-18:00		18:00	AP	4	CN
124	25/10/06- 06:00		06:00	AP	4	CN
125	25/10/06- 12:00		12:00	AP	4	CN
126	25/10/06- 18:00		18:00	AP	3	CN
127	26/10/06- 06:00		06:00	AP	2	CN
128	26/10/06- 15:45		15:45	AP	2	CN
129	26/10/06- 18:00		18:00	AP	3	CN
130	27/10/06- 06:00		06:00	AP	2	CN
131	27/10/06- 12:05		12:05	AP	2	CN
132	27/10/06- 18:00		18:00	AP	2	CN
133	27/10/06- 18:00		18:00	AP	1	CN
134	28/10/06- 06:00		06:00	AP	1	CN
135	28/10/06- 12:00		12:00	AP	1	CN
136	28/10/06- 12:00		12:00	AP	0,5	CN
137	28/10/06- 18:00		18:00	AP	2	CN
138	29/10/06- 18:00		18:00	AP	2	CN
139	30/10/06- 09:00		09:00	AP	2	CN
140	30/10/06- 12:00		12:00	AP	2	CN
141	30/10/06- 18:00		18:00	AP	3	CN

Abbreviations:
CN- Cellulose nitrate filter
PC- Polycarbonate filter

3.4. Oceanography and Marine Geology

3.4.1 CTD-O_2-chlorophyll-Fluorescence Probe *(N. Nowald, C. Reuter, M. Klann, G. Fischer)*

Ten CTD/O_2/chlorophyll-fluorescence profiles were taken with a self-contained SBE 19 profiler equipped with a conductivity-temperature-depth probe plus oxygen sensor and a CHELSEA-fluorometer. The sensors were calibrated prior to the cruise by the manufacturer except the CHELSEA-fluorometer. The chlorophyll-fluorescence probe was used to detect the chlorophyll maximum (sampling of dinoflagellate and coccolithophorid distribution). At the sediment trap mooring sites, we also took water samples for the classical determination of chlorophyll (see chapter below). Using a sampling rate of 2 samples/dbar, the CTD was deployed 10 m above the rosette or on ParCa system (Table 11). Profiles with the CTD were taken between 150m and 2600 m depth. The raw data were recovered on board and standard plots (mostly downcast plots) were immediately produced to evaluate the stratification of the water column, the chlorophyll maximum and the oxygen minimum.

Table.11: List of CTD-O_2-chlorophyll-fluorescence profiles.

Station GeoB	water depth (m)	profile depth (m)	attached to...	remark
11401-3	4150	220	ROS	20 m above rosette
11401-5	4150	2000	ParCa	within frame
11402-1	3797	2000	ParCa	within frame
11403-1	3375	2000	ParCa	within frame
11404-1	2698	2000	ParCa	within frame
11404-2	2682	2600	ParCa	within frame
11404-7	2690	2600	ParCa	within frame
11405-1	852	800	ParCa	within frame
11406-1	2119	2000	ParCa	within frame
11407-2	2699	2500	ParCa	within frame

3.4.2. Chlorophyll-a Measurements *(M. Klann, G. Fischer)*

For the determination of chlorophyll-a concentrations in the surface waters, seawater from the shipboard installed seawater pump ("Aquariumpumpe") was sampled when sailing (Table 12). Half a liter or one liter of seawater were filtered onto a glass microfibre filter (Whatman, GF/F, 25 mm diameter). The samples were frozen at dark and will be analyzed by means of photometry at the laboratory in Bremen. The results from the samples from the shipboard pump will be compared with satellite-derived chlorophyll concentration maps (SeaWiFs, MODIS) and may serve as calibration of these data.

Table 12: Sampling locations for chlorophyll-a measurements (shipboard aquarium pump).
T-S-data were taken from the ships' thermosalinograph.

No.	Date	Time (UTC)	Location LAT (N) LONG (W	Water-depth (m)	Salinity (‰)	Water-Temp. (°C)	Sample volume (l)	Station
1	23.10.	17:16	20°41.7 21°14.8	2837			0.5	CB16/17
2	24.10.	20:10	20°50.4 19°15.1	3370			0.5	
3	25.10.	08:05	20°50.5 19°15.2	3375			0.5	
4			20°45.1 18°42.0	2703			0.5	CBi-3/4
5			20°39.9 18°00.7	869			0.5	

3.4.3. Particle fluxes measured with sediment traps

(N. Nowald, C. Reuter, M. Klann, G. Fischer)

One aim of this part of the cruise was to recover and redeploy the moorings CB16/17 located about 200 nm off Cape Blanc (Mauretania/Morocco). This mesotrophic study site operated since 1988 is located at the edge of the Cape Blanc filament in about 4100 m water depth. An additional mooring named CBi-3 was deployed during a METEOR 65_2 cruise around 80 nm further to the east, this system was also planned to be exchanged. The data of deployments and recoveries of the moorings are listed in Table 13 together with the sampling data of the traps. On October 22, we successfully recovered mooring CB16 which was deployed by RV METOER in July 2005. It was redeployed as CB-17 with a similar configuration on October, 23. CB-16 provided two complete sample sets of each 20 cups. In the morning of Oktober 26, we recovered the 1500 m long mooring array CBi-3 in the coastal part of the Cape Blanc filament which was equipped with two traps and one current meter. A mooring with similar configuration was deployed on October, 27.. We received one complete sets of sediment trap samples of CBi-3. It is planned to recover and redeploy both mooring arrays with RV MS MERIAN in spring 2007.

Table 13: Data for recoveries and redeployments of the sediment trap mooring arrays.

Mooring	Position	Water depth (m)	Interval	Instr.	Depth (m)	Intervals (no x days)
Mooring recoveries						
Cape Blanc mesotrophic:						
CB-16	21°16,9' N	4160	25.07.05-	SMT 230	1205	20 x 21,5
	20°47,8' W		28.09.06	SMT 230	3633	20 x 21,5
				RCM 8	1258	
Cape Blanc eutrophic:						
CBi-3	20°45.6' N	2693	25.07.05-	SMT 230	1277	20 x 21,5
	18°41.9' W		28.09.06	SMT 234	1855	20 x 21,5
				RCM8	1300	
Mooring deployments						
Cape Blanc mesotrophic:						
CB-17	21°16.4'N	4152	24.10.06-	SMT 230	1204	20 x 7,5
	20°48.2'W		22.03.07	SMT 230	3614	20 x 7,5
				RCM 8	1257	
Cape Blanc eutrophic:						
CBi-4	20°44.9'N	2705	28.10.06-	SMT 234	1256	1 x 3,5, 19 x 7,5
18°42.0'W		22.03.07	SMT 241	1866		1 x 3,5, 19 x 7,5
				RCM8	1309	

Instruments used:
SMT 230/241/234 = Titanium particle sediment trap 243, Aquatec Meerestechnik, Kiel
RCM 8 = Aanderaa current meter, RCM 8

3.4.4. Particle distribution measured with optical systems

(N. Nowald, C. Reuter, M. Klann)

System description

The photographic particle camera system ParCa was deployed 9 times for the in-situ measurement of the particle size distribution (marine snow particles) and concentration of particulate matter in the water column. ParCa consists of a modified NIKON CoolPix 995 digital camera. A strobe, mounted perpendicular to the optical axis of the camera, provides a collimated light beam of 12cm width, illuminating a defined sample volume. Power Source is a 24V/38 Ah rechargeable lead battery designed for the use to full ocean depth. ParCa can operate in depths up to 3000m. All devices are mounted in a 200kg galvanised frame. Communication with the ship is done by a microcontroller and adapted software. An additionally installed SeaBird PDIM telemetry provides full control of the entire system, via the ships coaxial wire. Pictures were exposed while lowering the system at a speed of 0,5m/sec at approx. each 12m of depth. A detailed station list (Table 14) is given below.

Table 14: List of sites where ParCa profiles have been obtained.

GeoB #	Date 2006	Time seafloor/ max. wire -length (UTC)	Latitude	Longitude	Water depth (m)	Deploy depth (m)
11401-5	23.10.	06:30	21°17.5 N	20°48.0 W	4154	Down to 2000
11402-1	24.10.	07:01	21°00.0 N	19°59.5 W	3798	Down to 2000m
11403-1		19:51	20°50.4 N	19°15.1 W	3374	Down to 2000m
11404-1		20:01	20°45.4 N	18°42.3 W	2698	Down to 2000m
11404-2	26.10.	08:28	20°45.4 N	18°42.2 W	2697	Down to 2600m
11404-7		20:13	20°45.3 N	18°42.2 W	2698	Down to 2600m
11405-1	28.10.	07:33	20°39.8 N	18°00.5 W	852	Down to 800m
11406-1		20:02	19°45.1 N	18°05.2 W	2122	Down to 2000m
11407-2	29.10	17:54	20°45.5 N	18°42.5 W	2697	Down to 2500m

Preliminary results

The camera profiles show very similar distribution patterns as observed during previous cruises. The characteristical sub-surface maximum around 400m-500m depth is a typical feature in the abundance pattern off Cape Blanc and the result of filament activity in this region. The material is advected several hundreds of kilometers offshore towards the open ocean. This is an important mechanism regarding the re-distribution and quality of particulate matter off Cape Blanc. A special sedimentation event was observed between the 26th and 29th of October (Fig. 1). A sinking particle cloud was tracked for three days at the same site, showing a vertical offsett of approx. 125m during the observation period. An identical profile was aqcuired in 2001 during RV POSEIDON cruise 272, but could not be tracked over time. These profiles prove the existence of sinking events, where large amounts of larger particles are transferred rapidly from the ocean surface to the seafloor.

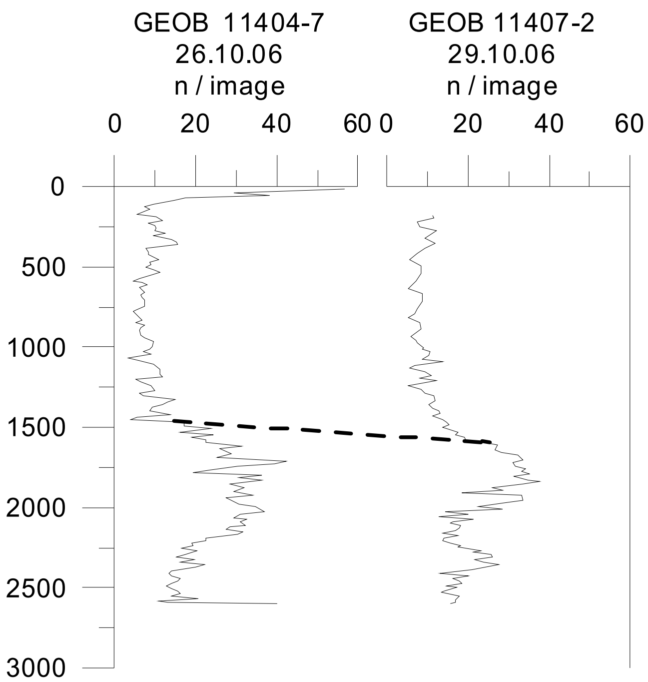


Fig. 2: Deep particle maximum obtained with ParCa between October 26 and 29, 2007, showing an apparent vertical offset of about 125m between the three days of observation.

3.4.5 Particle investigations with the ROV *Cherokee*

(N. Nowald, C. Reuter, M. Klann, W. Dimmler)

System description

The *Cherokee* ROV is a commercially available, mid-size inspection class ROV, manufactured by SUB-ATLANTIC, Aberdeen. The system consists of three major components: a spooling winch, the Surface Control Units (SCU) and the vehicle itself. Vehicle dimensions are 120x80x100cm (LxBxH) with a weight in air of 300kg. *Cherokee* has a payload for scientific equipment of approx. 25kg. The ROV is electrically propelled by 4 axial thrusters (440 VAC) and total power of the entire system is 12kW. *Cherokee* can operate in depths down to 1000m.

Optical devices are 1 high resolution colour zoom video camera and 1 NIKON still camera, mounted onto a Pan/Tilt unit. Two additional cameras are mounted for the overview to the front and the back area of the vehicle. Four lasers are likewise mounted onto the Pan/Tilt unit for size calibration of objects at the seafloor. Light is provided by 4 240V/250W DSPL dimmables. A compass and other sensors provide navigational data such as heading and depth. A *Tritech* scanning sonar generates images of objects or structures in the water column or on the seafloor within a range of 300m. The sonar transmits its data directly to the SCU where an online image is displayed. *Cherokee* is equipped with a hydraulic, 5 function manipulator and a sample box on a tools kid. Both allow the collection of objects from the seafloor and/or the operation scientific tools.The SCU consists of 3 control racks, in which video signals and navigational data are displayed. A data acquisition computer collects data from the ship and the ROV. Video, navigational ship and ROV data are all time referenced and stored on DV video tapes or as ASCII files respectively, for further processing. The vehicle is operated by a remote console for manoeuvring and navigation. The winch is electrically powered and bears the 1000m umbilical cable. The umbilical contains several electrical conductors for electrical power and basic telemetry. 4 optical fibres are provided for video transmission (4 channels) and additional telemetry channels (4xRS232 and 4xRS485).

Scientific payload

The vehicle was modified in order to sample and to measure sinking velocities of particulate matter in the water column. The prototypes of three transparent water samplers were mounted in the field of vision of the ROV cameras, just in front of the vehicle (Fig. 2). The closing of each sample bottle was achieved by pulling a release rope with aid of the manipulator. A caliper was mounted inside of each sampler for measuring the sinking velocities with the cameras inside the bottles. Although only one dive could be performed, this system proved to be suitable for sampling and measuring sinking speeds in-situ. The videos will be analysed and evaluated at the University of Bremen.

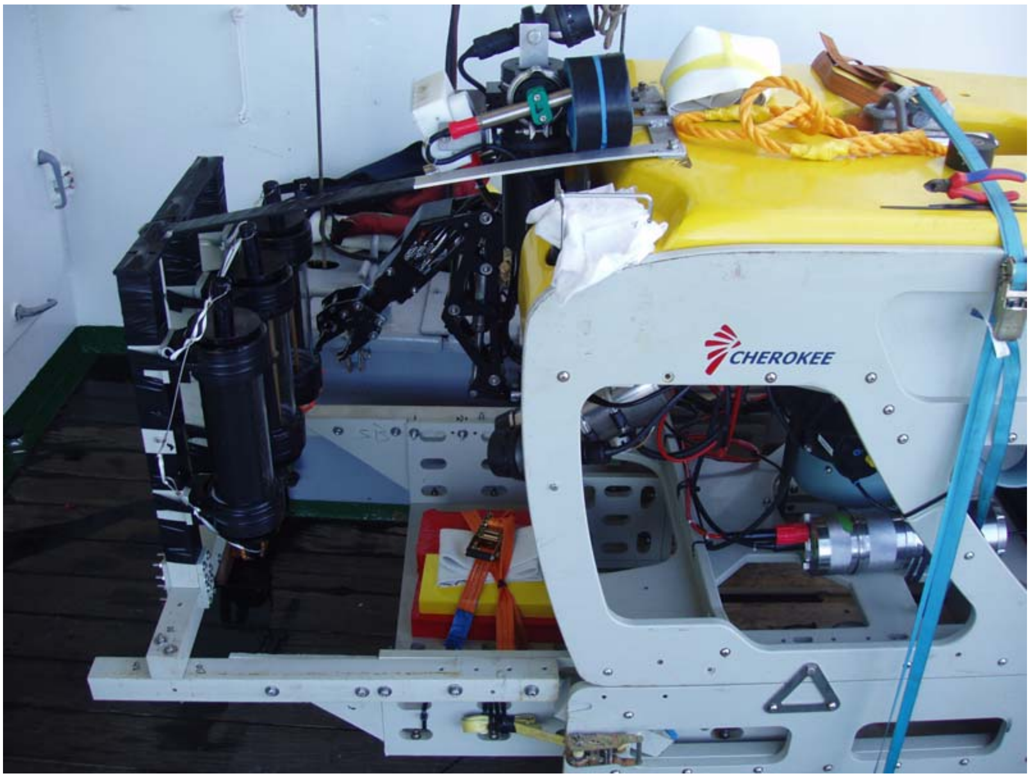


Fig.3: Particle samplers for the observation of larger particles were mounted in front of the ROV *Cherokee*.

4. Station List (POS 344 Leg 1)

GeoB #	Ships #	Date	Device	Time seafloor/ max. wire - length [UTC]	Latitude	Longitude	Water depth [m]	Recovery/Remarks
11401-1	869	22.10. .	CB 16	12:31	21°16.6 N	20°48.4 W	4156	Mooring recovery, all instruments have been working, 2 traps, 1 current meter
11401-2	870		GoFlo	18:14	21°17.2 N	20°47.8 W	4152	only one cast at 200m worked
11401-3	871		ROS + CTD	19:23	21°16.9 N	20°47.7 W	4150	test with CTD-O_2_chl 20 above ROS; casts: 219,201,175,150,124,99,75,30m
11401-4	872		GoFlo	20:05	21°16.9 N	20°47.7 W	4150	3 casts realeased to early casts: 100,150,200m
11401-5	873	23.10.	ParCa with CTD	06:30	21°17.5 N	20°48.0 W	4154	Down to 2000
11401-6	874	23.10.	CB17	09:38	21°16.4 N	20°48.2 W	4152	Slip ankerstone, mooring deployment successful
11401-7	875		ROV *Cherokee*	11:17	21°16.5 N	20°46.5 W	4148	Deployment, tests at surface
11401-8	876		ROS	13:15	21°16.5 N	20°46.4 W	4152	Casts: 2x100, 2x50,2x40,2x30,2x20,2x10m
11401-9	877		ROS	14:18	21°16.6 N	20°46.5 W	4151	Casts: 200,150,125,100,75,60,3x50,40,25,10m
11401-10	878		GoFlo	15.52	21°16.2 N	20°46.5 W	4146	Down to 750m: casts at: 25,50,250,300,400,500,600,750m
11402-1	879	24.10.	ParCa with CTD	07:01	21°00.0 N	19°59.5 W	3798	Down to 2000m
11402-2	880		ROS	08:02	21°00.1 N	20°00.3 W	3800	Down to 50 m Casts: 2x50, 2x45, 2x40, 2x30, 2x20, 2x10m
11402-3	881		ROS	08:57	21°00.1 N	20°00.2 W	3800	Down to 200m Casts: 200, 150, 100, 75, 60, 50, 45, 40, 25, 10m
11403-1	882		ParCa with CTD	19:51	20°50.4 N	19°15.1 W	3374	Down to 2000m
11403-2	883	25.10.	ROS	08:13	20°50.1 N	19°14.9 W	3375	Down to 60m Casts: 60, 50, 40, 30, 20, 10m
11403-3	884		ROS	08:52	20°50.1 N	19°14.8 W	3375	Down to 200m Casts: 200, 150, 125, 100, 75, 3x60, 50, 40, 25, 10m #10 was empty
11403-4	885		ROS	09:55	20°50.1 N	19°14.8 W	3375	Down to 800m Casts: 800, 600, 500, 400, 300, 250, 200, 150, 50, 10, 75, 500m
11403-5	886		GoFlo	11:33	20°50.7 N	19°14.9 W	3374	Down to 750m Casts: 25, 100, 200, 300, 400, 600, 750m
11404-1	887		ParCa with CTD	20:01	20°45.4 N	18°42.3 W	2698	Down to 2000m

GeoB #	Ships #	Date	Device	Time seafloor/ max. wire - length [UTC]	Latitude	Longitude	Water depth [m]	Recovery/Remarks
11404-2	888	26.10.	ParCa with CTD	08:28	20°45.4 N	18°42.2 W	2697	Down to 2600m
11404-3	889		CBi_3	09:22	20°45.5 N	18°42.4 W	2700	Released, only upper trap worked
11404-4	890		ROS	12:13	20°45.4 N	18°42.2 W	2695	Down to 40m Casts: 2x40, 2x30, 2x25, 2x20, 2x15, 2x10m
11404-5	891		ROS	12:51	20°45.4 N	18°42.2 N	2699	Down to 125m Casts: 125, 100, 75, 60, 50, 3x40, 30, 25, 20, 10m
11404-6	892		ROS	14:30	20°45.2 N	18°42.3 N	2700	Down to 2400m Casts: 2x2400, 2x2100, 2x1900, 2x1700, 1150, 600, 2x35m
11404-7	893		ParCa with CTD	20:13	20°45.3 N	18°42.2 W	2698	Down to 2600m
11404-8	894	27.10.	CBi_4	08:30	20°44.9 N	18°42.0W	2705	Slip ankerstone, deployment of sediment trap mooring
11405-1	895	28.10.	ParCa with CTD	07:33	20°39.8 N	18°00.5 W	852	Down to 800m
11405-2	896		ROS	08:46	20°40.0 N	18°00.4 W	862	Down to 100m Casts: 2x50, 2x40, 2x30, 2x25, 2x20, 2x15m
11405-3	897		ROS	09:29	20°40.1 N	18°00.3 W	862	Down to 125m Casts: 125, 100, 3x75, 60, 50, 40, 30, 25, 20, 15m
11405-4	898		ROS	10:27	20°40.2 N	18°00.2 W	859	Down to 700m Casts: 2x700, 600, 2x350, 250, 200, 100, 70, 20m
11406-1	899		ParCa with CTD	20:02	19°45.1 N	18°05.2 W	2122	Down to 2000m
11406-2	900		ROS	21:22	19°45.0 N	18°05.1 W	2125	Down to 200m Casts: 2x200, 2x150, 2x100, 2x50, 2x30, 2x15m
11407-1	901	29.10.	ROV *Cherokee*	13:52	20°45.3 N	18°42.4 W	2703	Deployment, down to 200, with particle sampler, 3 samples taken at 30 and 25m
11407-2	902		ParCa with CTD	17:54	20°45.5 N	18°42.5 W	2697	Down to 2500m

CB, CBi - Sediment trap mooring sites off Cape Blanc (Mauretania)

ROS/CTD – Multi-water sampler with CTD (SBE 11, Kiel)

PARCA – Particle Camera System (mostly with CTD SBE-19 inside frame)

ROV – Remotely Operating Vehicle (Cherokee)

GoFlo – casts on Kevlar wire

CTD-O_2_chl_f (SBE 19, #2069): with oxygen and chlorophyll fluorescence sensor

LEG 2

5. Research Objectives

The area off NW-Africa is one of the most important upwelling systems of the global ocean. High amounts of Sahara dust influence the transport of nutrients into and their concentration in the ocean and therefore play a major role for the particle production in the ocean influencing the processes of the biological carbon pump system. Hence they are controlling factors of the global atmospheric CO_2-budget. Despite the main driving force for climatic variability located in the North Atlantic, the upwelling area off NW-Africa is suitable to reconstruct the past climatic variability by monitoring present in-situ environmental changes and variations.

The research topics carried out were in correlation with the project MERSEA (**M**arine **E**nvi**R**onment and **S**ecurity for the **E**uropean **A**rea – Integrated Project). The main aim of MERSEA is the data management and processing to take aim to the needs of scientific end-users.

The participating institutions during R/V POSEIDON cruise 344-2, MARUM/University of Bremen and ICCM, are involved in work package 3. They will ensure the availability of real time and delayed-mode and regional in-situ data and products in the form required by the MERSEA modelling, data assimilation and validation systems. The activities are partly research and development, innovation, and partly demonstration. The served research sites, continued from the preceding ANIMATE and DOLAN projects, are DOLAN/ESTOC, Canary Islands; PAP, Porcupine Abyssal Plain; CIS, Central Irminger Sea. The main task during the POS 344-2 cruise will be the work on the DOLAN site. The DOLAN station is located 25 nm west of ESTOC and comprises technical devices for transmission of scientific data sets via satellite into the research institutes which collect the data in a database and make them available in the internet.

6. Narrative

R/V POSEIDON left Las Palmas in the morning of Nov 4th, 2006 and steamed to the DOLAN buoy position. It was planned to recover the buoy, do a transect of CTD stations north of the Canary Islands, then continue west of La Palma to the South and went back on a transect between La Palma and La Gomera to the buoy position for a new deployment.

In the afternoon of Nov 4th, 2006 POSEIDON arrived at the first station and the recovery of the buoy started immediately. Afterwards a CTD calibration cast has been done. The ship steamed easterly to the ESTOC monitoring station where it arrived at night. Here a turtle and three NOAA drifter buoys have been released for a monitoring experiment. Due to a technical problem POSEIDON had to steam back to Las Palmas where she arrived the next morning. After repair has been finished in the evening the ship steamed to the first position of the planned CTD transect starting west of DOLAN.

POSEIDON arrived Nov. 6th, 2006 at the station and the CTD work started immediately. The CTD transects north of the islands, west of La Palma and between La Palma and La Gomera were made the next three days. Altogether 10 CTD stations each consisting of two casts have been achieved.

Nov 10th the ship arrived again at the DOLAN position. A pre-calibration cast had been done before the buoy was deployed at it's original position. Afterwards some communication tests were made.

The next day (Nov. 11th, 2006) three CTD stations have been achieved (#2, #13 and ESTOC). Here the scientific program finished and POSEIDON took course towards Las Palmas where she arrived Nov 12th, 2006.

7. Scientific Report

7.1 Equipment Development and Tests

The Surface Buoy Unit (SBU) operates since 1997 and was formerly part of the DOMEST project. The unit carries several meteorological sensors, satellite telemetry links and sub sea telemetry links like ORCA acoustic modem and a cable-telemetry down to 100m.
The current DOLAN buoy mooring location is 29°11.30`N 15°55.60`W at a water depth of 3628m.
The upper 100m of the DOLAN mooring including all sensors was recovered for maintenance on the evening of the November 4th, 2006.
The redeployment took place on November 10th, 5 days later.
The last routine maintenance has been carried out during R/V POSEIDON cruise 333 in March 2006.

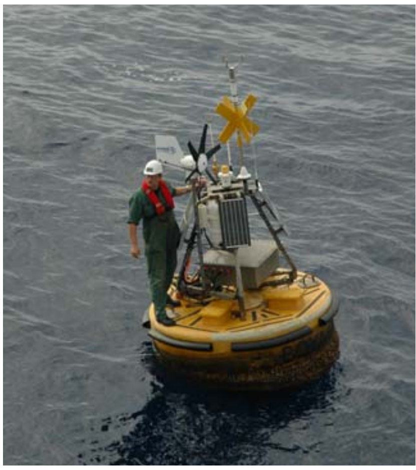


Fig. 4: Recovery of the SBU.

The bio fouling on the sensors and the buoy was at a low level. This was always the case on the December cruises. This seasonal change has been seen on all cruises. The sensors and the buoy have been cleaned before reading all the data from the sensors.
There were no major damages visible on the buoy, all antennas, solar panels and cables on deck were in a good shape. Some damages on the body of the buoy have been detected.

Fig. 5: Recovered SBU.

Status of the DOLAN buoy before maintenance

The visual inspection of the buoy's body shows cracks and damages at 2 different locations. The visible damage has been repaired. Some more serious repairs can be expected for the next cruises. Two cables were destroyed by corrosion, the Iridium Antenna cable and the CAN Bus cable to the 100m sensors. The Iridium antenna was also destroyed by corrosion.

Status of the sensors and SBU

INMARSAT GPS Tracking (MARUM)

The INMARSAT tracking system installed in December 2004 performed well until May 28th, 2006. The battery capacity installed on the PO333 cruise has been doubled compared to previous deployments. 15 Blocks of 14Ah@15V each have been installed. The needed capacity has

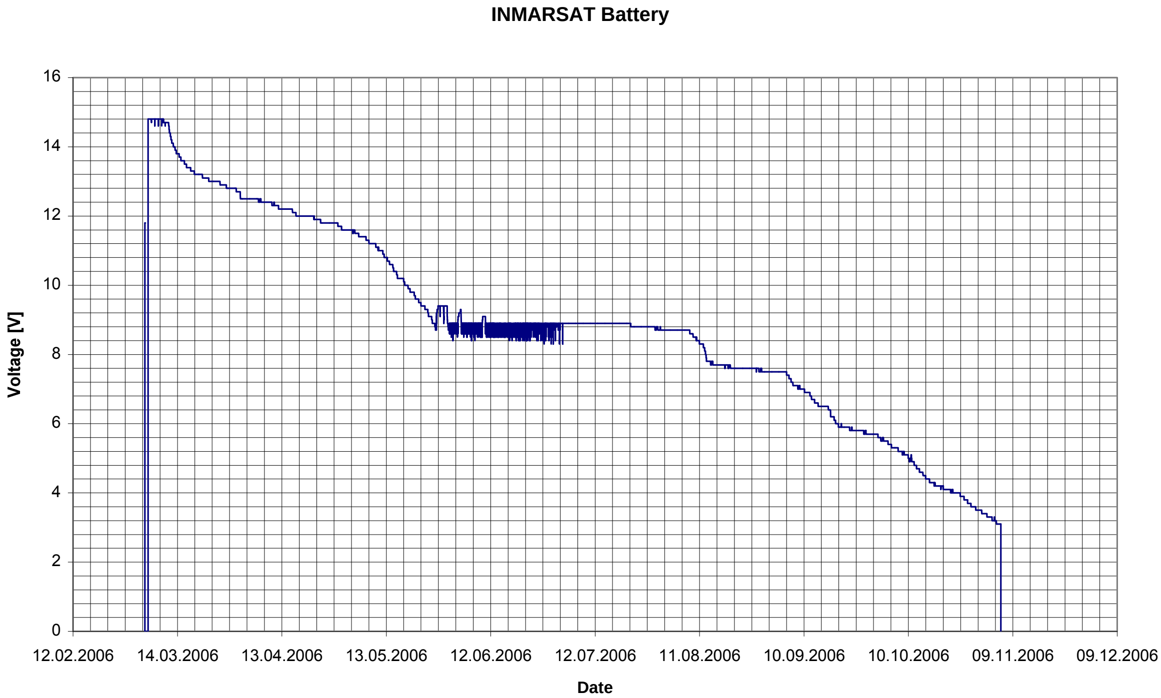


Fig. 6: INMARSAT Power log

been estimated based on the previous deployments. The Inmarsat transmissions stopped in May while the battery power has been estimated for one year. The voltage log of the Inmarsat Battery shows that the voltage decreases rapidly until the 27.05.06 where the critical voltage (9V) for the operation has been reached. This could be interpreted in a way that the INMARSAT Transceiver has not been in the power save mode after the last deployment.

Vaisala Weather Sensors
(Air temperature, humidity and barometric pressure, MARUM)

- The air pressure has been working well all the time and the data was in the online telemetry during the whole past mooring period. This sensor has not been replaced.
- The weather sensors with relative humidity and air temperature sensor have been equipped with a special membrane during the last maintenance. The membrane protected the sensors from the contact with sea water.

Vaisala Acoustic Wind Speed Sensor WS425 and TCM2 Compass (MARUM)

- The acoustic wind speed sensor and the compass is working well; the data are transmitted now via the Iridium- online-telemetry.

Microcats (IFM-GEOMAR)

- There was one Microcat installed at 10m and one Microcat at 0.5m mounted at the buoy.

The 0.5m Microcat performed well during the whole mooring period but the 10m Microcat sent data until March 28th, 2006. The batteries were empty after this date.

The Orbcomm telemetry worked very well during this mooring period with GPS and air pressure as well as the new measurement of the Battery Voltages. The data from the Microcat in 0m and 10m have been transmitted. The bio fouling on the Microcats was acceptable. The recorded data could be retrieved completely (for the 10m Microcat only data until 28.3.06).

There were 4 inductive Microcats between 10m and 100m. The have been recovered and the data has been downloaded successfully. The antifouling of the 100m serial Microcat has been replaced.

RDI Long Ranger ADCP (IFM-GEOMAR)

- The data of the ADCP at 150m has been downloaded completely, the battery has been renewed.

Wet Labs FLNTU Fluorometer (NOC)

The fluorometer was connected to the telemetry, but no measurement has been performed and no data has been transmitted due to the fact that the power plug was not available on the last cruise. The WetLabs fluorometer and the nutrient analyser in 100 m water depth were only very slightly affected by bio fouling. The bio-wiper of the fluorometer worked well, so that its optical system has been found without any bio fouling film. The wiper was not in place when the fluorometer was recovered. It has been lost during the last mooring period.

The wiper was not included in the fluorometer spare part set. The instrument has been deployed without wiper on this cruise.

A calibration cast has been performed for the fluorometer, but we were not able to download the data from the instrument although the data was present in the instruments memory.

This has to be analysed after the next mooring period.

The NAS Nutrient sensor (ICCM)

- The intake of the nutrient analyser was not affected by bio fouling as well.

The nutrient NAS-2E sensor has not been connected to the telemetry due to problems with the firmware inside the sensor.

DOLAN Surface Buoy (SBU, MARUM)

The maintenance of the buoy electronics showed that the buoy was in a good shape.

There were three major problems:

A) There was a short circuit in the CAN Bus telemetry cable on the 24V power supply. This did not trigger the fuse but it leads to a discharge of the 24V battery within 6hours. The short circuit occurred one hour after the post deployment tests on the PO333 cruise in March. The next contact via Iridium Dial in was too late to correct the problem manually. (see 24V voltage log)

B) The Iridium antenna cable was completely corroded at the connector and the antenna was destroyed by corrosion.

C) The Iridium modem was not working any more, even the AT-command interface was not answering in a proper way.

SBU Power supply

Both, 12V and 24V power supply systems were working well. No corrosion was found in the junction box of the solar panels or in the wind generator or connecting cables.
The 12V power supply shows a good performance during the whole mooring period.

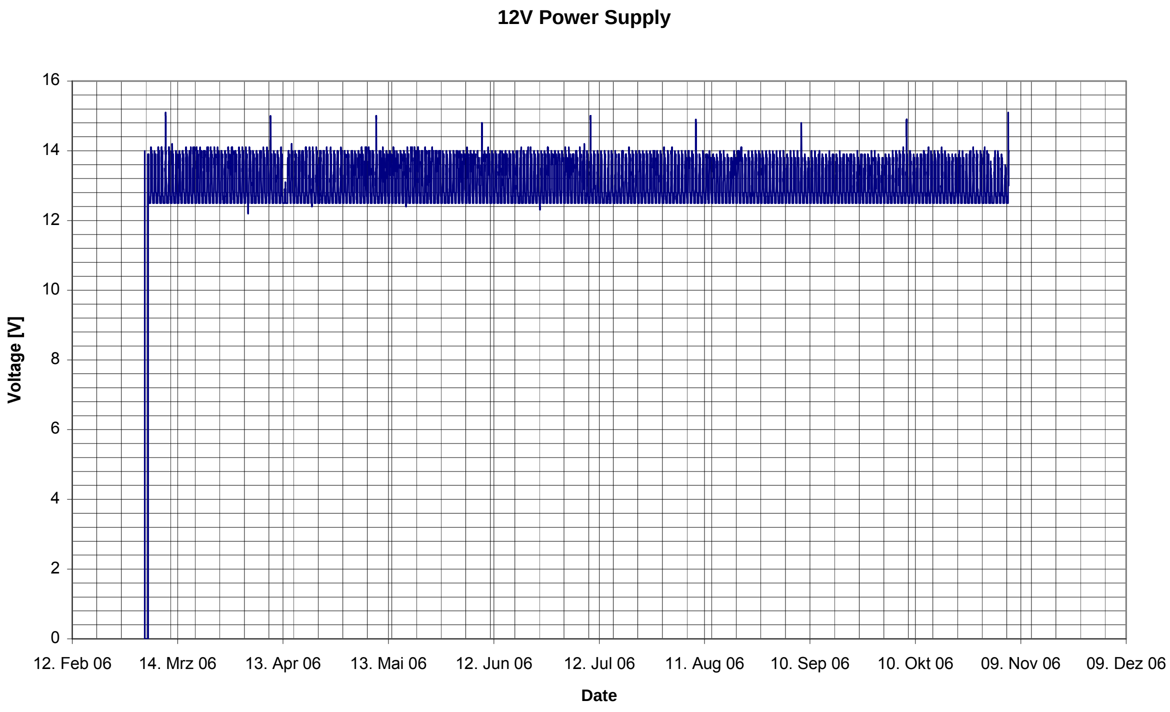


Fig. 7: Plot of the 12V power supply during the deployment period.

The short circuit event in the 24V circuit has been detected by analysing the 24V voltage log. The Voltage was below the deep discharge level after the first day of the deployment. This destroyed the 24V battery and after this event no recharge was possible.

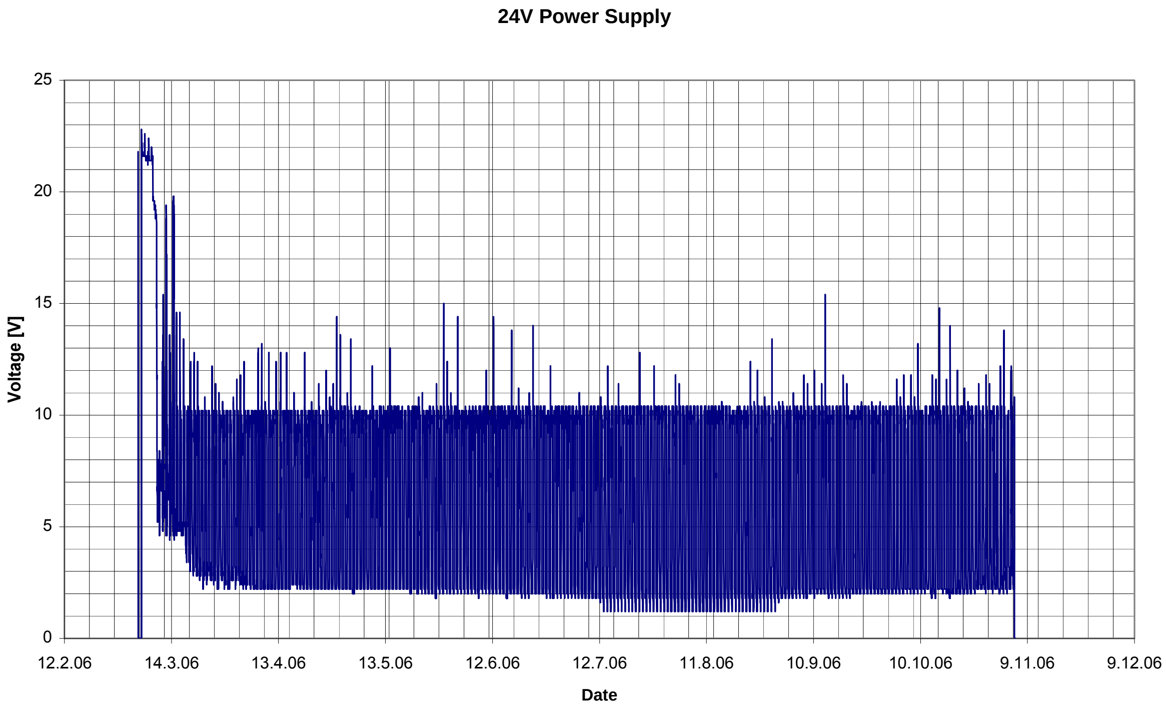


Fig. 8: Plot of the 24V power supply during the deployment period.

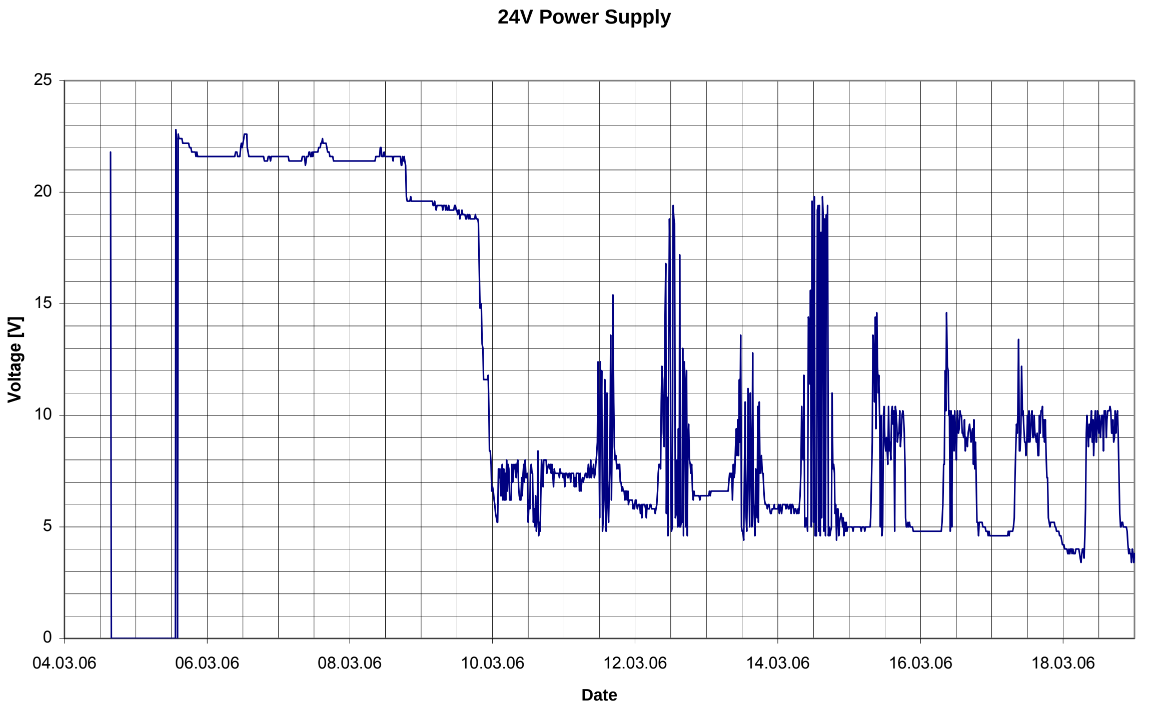


Fig. 9: Plot of the 24V power supply; the first days.

The plot of the first days shows that the voltage starts to decrease at 9.3.06 19:16UTC.
The battery was approx 5.2V at 10.3.06 01:56. The buoy was deployed at 8.3.06 17:42 UTC. The tests of the whole system via the WLAN link lasts until 18:15 UTC. The WLAN was switched off and the ship left the DOLAN position for Las Palmas after this time.

The log file for the current consumption shows a constant current for the 24V supply until of 450mA until 19:02. The current raises to 2131mA at this time, it was constant until the end of the log files (09.03.06 23:12 UTC). The DOLIX computer stopped working at this time.

We tested the CAN bus sub-sea cables and found the short circuit in the cable from the buoy down to 20m along the chain. The wire inside was broken and the 24V line was short circuit to the GND line.
It is likely that the cable has been damaged during the deployment of the 20m chain when the cable was going with the chain into the water.

The cables have been replaced during the PO344-2 cruise. The CAN bus telemetry is performing well, the data from the 100m Microcat are currently in the online telemetry.
The 12V power supply and the 24V power supply are working well, both batteries are fully charged.

The solar panels for the 12V and the 24V power supply have been tested, they are working well and the cables are not corroded.
The charging regulators for the 12V and the 24V power supply are working as well.
The deep discharge protection has been activated on the 12V and the 24V net.

The wind generator is also charging the 24V battery, the cables are not corroded. The bearings do not need any maintenance on this cruise. Also the charging regulator is in a good condition.

WLAN link

The WLAN was working well on the buoy; the link was very useful for the maintenance on deck as well as for the first tests after the redeployment of the buoy.

CAN Bus Telemetry

The cables of the CAN bus telemetry have been replaced. The upper cable has a mechanical damage. The lower 85m had an isolation problem due to water in the cable. The connection with the sub sea connector at 20m depth was not sealed. The used technique does not comply with the new PU CAN cable. We have chosen a new technique with a PU pottant and liquid tape sealing.
The CanSor modules have installed in plastic pressure housing with bulkheads.
This enables a flexible extension and configuration of the sensors and the cable.

Overview on the installed sensors / telemetry since November 2006

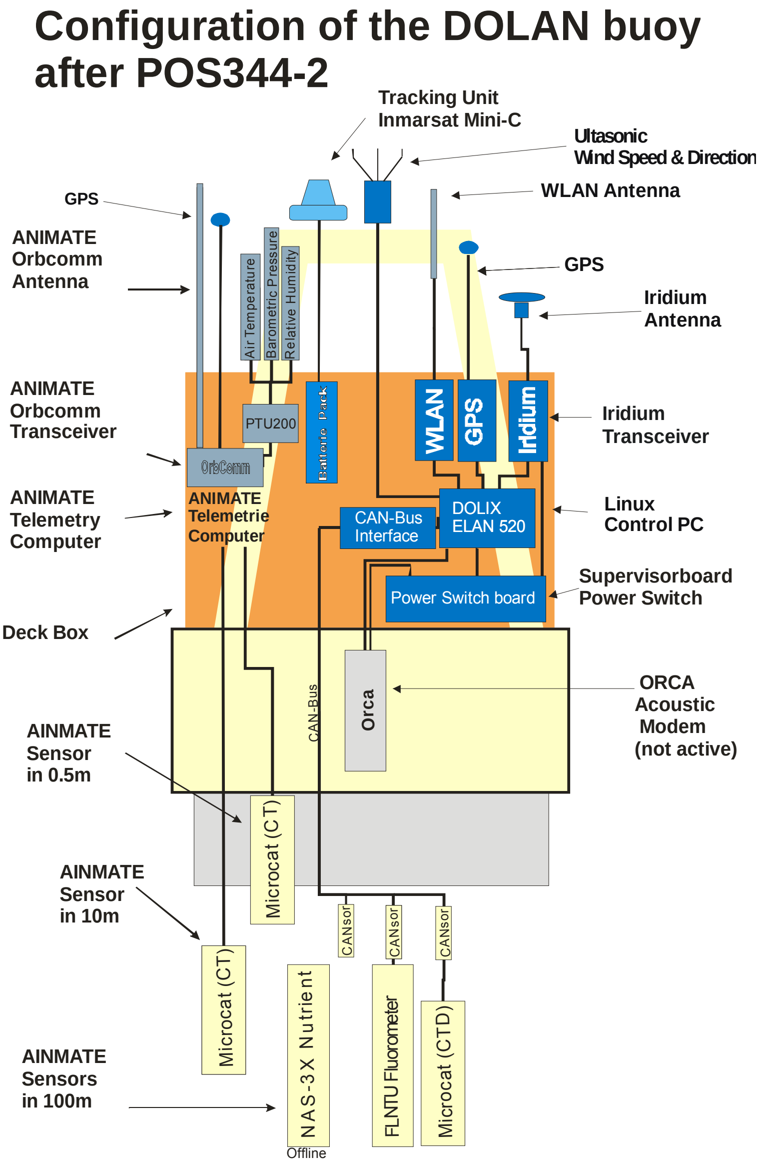
Table 15: Installed sensors on the buoy

Sensor	Telemetry	Status
Vaisala PTU200 - air temperature - relative humidity - barometric pressure	ORBCOMM	ONLINE
Vaisala WS245 - windspeed - winddirection	IRIDIUM	ONLINE
TCM2 - buoy heading - pitch and roll for the buoy	Working, delivers data for wind speed calculation	ONLINE
Thrane & Thrane - GPS	INMARSAT	OFFLINE
Microcat @0.5m	ORBCOMM	ONLINE
Microcat @10m	ORBCOMM	ONLINE
Microcat @100m	IRIDIUM	ONLINE
Fluorometer	IRIDIUM	(ONLINE)
Nutrient Analyser NAS-3E	Not in telemetry	
DOLIX GPS	IRIDIUM	ONLINE

Results of the tests before and after deployment

All tested sensors and systems were working well during the tests prior to the deployment.
The tests after the deployment were successful as well. We performed a successful login on the DOLIX computer via Iridium several times.
One failure in the CAN software on the DOLIX computer has been detected. The fluorometer data are received on the DOLIX computer but are not correctly processed.
The wind speed data shows in some measurements a reading of more than 360 degrees in the wind direction. This has to be analysed as well.
These two failures can be analysed and corrected via the Iridium dial in link from Bremen.
The corrected software has to be tested in detail before the update of the DOLIX computer.

DOLAN configuration November 2006



No new sensors have been implemented on the DOLAN buoy on this cruise. The focus was on the maintenance and improvement of the installed system. Several problems in the software have been corrected.
The test of the installed system shows a very good performance and a stable system.

The redeployment of the mooring took place on the 10.11.06. 15:52 UTC
Tests of all sensors on the DOLIX took place after the deployment of the DOLAN buoy.
All sensors were working fine.
These tests have been performed via the WLAN link on the buoy at a distance of ½ nm and via the Iridium link.
The log files have been retrieved via Iridium and the performance of the system has been controlled after the deployment and during the next days as well.

Fig. 10: Configuration of the DOLAN SBU after POS cruise 344-2.

Status of the tasks from the POS333 cruise

- connection of CanSor modules on the cable via Subconn connectors
  - The CanSor circuits have been installed in an pressure housing with connectors
  - The CAN cable has been split into shorter parts to enable an easier handling during the recovery of the mooring.
- Check of the CanSor telemetry for the 100m Microcat
  - The telemetry is working well now
- New revision of the CanSor software with bidirectional telemetry
  - The new software has been installed in the CanSor with the bidirectional link and an 8Byte per data block transmission.
  - The DOLIX can software has been updated for the same features

Tasks for the next cruise

- The DOLIX can software seams to have an failure
- The wind averaging software should be checked
- The fluorometer has to be replaced in order to check the instrument at the NOC

8. Marine Chemistry

8.1 Objectives and scientific questions

Along P344_2 the ANIMATE/ ESTOC mooring was recovered and redeployed for the nineth time. It had been put in place in March 2006 during P333 and the sensors had been in the water for about 8 months and needed to be replaced. The ICCM had to exchange the nitrate sensor and extract the data; a new one was put in the mooring in order to remain the time-series.

At the same time it was necessary to do the biogeochemical monthly samplings at the ESTOC station (**E**uropean **S**tation for **T**ime series in the **O**cean **C**anary islands) and surrounded areas, that it has been continuously done since 1994. Calibration casts with CTD/Rosette were also made to accomplish the requirements of the sensors being recovered/ deployed.

Further stations were made to check the intermediate waters in the western passage among Tenerife, Gomera, Hierro and La Palma Islands, with the aim to track the presence of the Antarctic Intermediate Water (AAIW). Variability of this water mass is found to the north of the archipelago due to the circulation through the passages between the different islands.

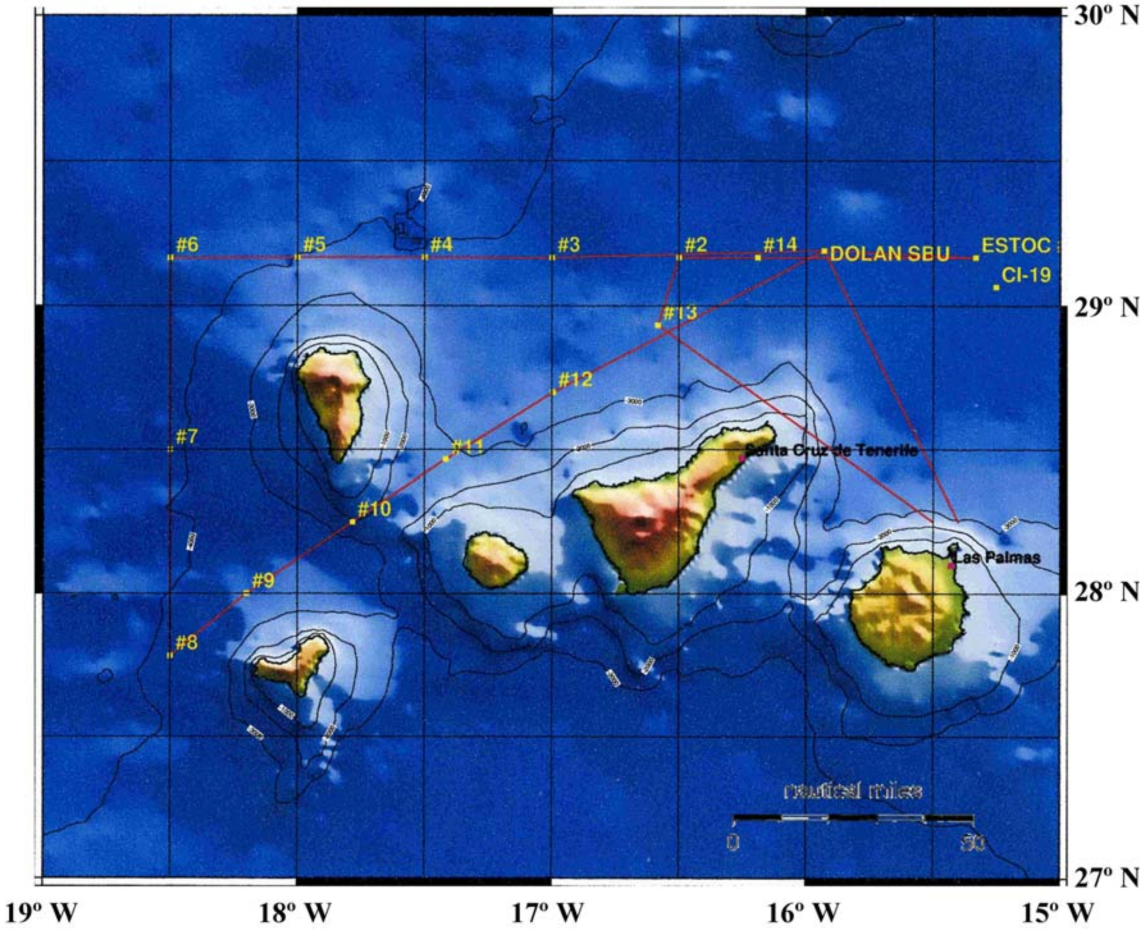


Fig. 11: Track of the P344_2 (red line). CTD stations are shown and numbered in yellow colour.

8.2.Scientific works

At the beginning of the cruise the DOLAN/ANIMATE mooring had to be recovered, hence a rosette/CTD cast to 500m was made in order to have a calibration of the chemical sensors before their recovery (st. #903 from the ship system; recovering calibration). After the DOLAN mooring

with the physical and biogeochemical sensors from the MERSEA was recovered, the ship steamed to ESTOC. At the station, three NOAA buoys (#62290, #62292 and #62294) were deployed together at 29.167 N, 15.166 W and a turtle was returned to sea (AEGINA project; MAC/3.5/C36).
.
After this, a survey triangle was carried out (see figure 1; from station number two to fourteen) taking hydrography and biochemistry measurements by use of Seabird CTD and rosette, respectively. The CTD and rosette stations were driven to 2000m except the corner stations on the triangle that were made to the bottom. Returned to DOLAN site a calibration was made prior to the mooring deployment (to 500m). After deployment of the buoy and made the communication tests the ESTOC station monthly sampling took place (sampled to the bottom) as part of the monthly sampling at ESTOC since 1994. Once ESTOC monthly program was ended the ship moved to west for closing the survey triangle (st. 2 and 13) and finally the vessel returned to the port of Las Palmas.

Table 16: List of stations sampled along the cruise P344_2, Las Palmas-DOLAN-ANIMATE-DOLAN-Las Palmas (0=oxygen, N=nutrients, S=salinity, C=chlorophyll “a”, A= Alkalinity, pH, Inc= Incidences) .

Date Time (hh:mm	**St. #, CTD Cast**	**Depth sta,m**	**Lat. N**	**Long. W**	**Depth Ro,db**	**Nisk bot.**	**Depth samp, db**	**PARAMETERS** O	N	S	C	A	PH	Inc
04.11. 2006	Cal.		29º10’	15º55’	300			Test cast for chemical pack calibration before recovery						
						1	300	√	√	√				open
						2	200	√	√		√			
						3	150	√	√		√			
						4	125	√	√		√			
						5	100	√	√		√			
						6	90	√	√		√			
						7	80	√	√		√			
						8	70	√	√		√			
						9	55	√	√		√			
						10	40	√	√		√			
						11	25	√	√		√			
						12	10	√	√	√	√			
06.11. 2006	# 3, 01	3883	29º10’	17º00’	2000									
						1	2000	√	√	√		√	√	
						2	1800	√	√	√		√	√	
						3	1500	√	√	√		√	√	
						4	1300	√	√	√		√	√	
						5	1200	√	√	√		√	√	
						6	1100	√	√	√		√	√	
						7	1000	√	√	√		√	√	
						8	800	√	√	√		√	√	
						9	600	√	√	√		√	√	
						10	400	√	√	√		√	√	
						11	300	√	√	√		√	√	
						12	10							
Date Time (hh:mm	**St. #, CTD, Cast**	**Depth sta,m**	**Lat. N**	**Long. W**	**Depth Ro,db**	**Nisk bot**	**Depth samp, db**	**PARAMETERS** O	N	S	C	A	PH	Inc
06.11. 2006	# 3, 02	3883	29º10’	17º00’	200									
						1	200	√	√	√		√	√	
						2	150	√	√	√		√	√	
						3	125	√	√	√		√	√	

						4	100	√	√	√		√	√	
						5	75	√	√	√	√	√	√	
						6	50	√	√	√	√	√	√	
						7	25	√	√	√	√	√	√	
						8	10	√	√	√	√	√	√	
						9	10							
						10	10							
						11	10							
						12	10							
06.11. 2006	# 4, 01	3850	29º10’	17º30’	2000									
						1	2000	√	√	√		√	√	
						2	1800	√	√			√	√	
						3	1500	√	√			√	√	
						4	1300	√	√			√	√	
						5	1200	√	√			√	√	
						6	1100	√	√			√	√	
						7	1000	√	√			√	√	
						8	800	√	√	√		√	√	
						9	600	√	√			√	√	
						10	400	√	√			√	√	
						11	300	√	√	√		√	√	
						12	10	√	√					
06.11. 2006	# 4, 01	3850	29º10’	17º30’	200									
						1	200	√	√	√	√	√	√	
						2	150	√	√		√	√	√	
						3	125	√	√		√	√	√	
						4	100	√	√		√	√	√	
						5	75	√	√		√	√	√	
						6	50	√	√		√	√	√	
						7	25	√	√		√	√	√	
						8	10	√	√	√	√	√	√	
						9	10							
						10	10							
						11	10							
						12	10							
06.11. 2006	#5, 01	3689	29º10’	18º00’	2000									
						1	2000	√	√	√		√	√	
						2	1800	√	√			√	√	
						3	1500	√	√			√	√	
						4	1300	√	√			√	√	
						5	1200	√	√			√	√	
						6	1100	√	√			√	√	
						7	1000	√	√			√	√	
						8	800	√	√			√	√	
						9	600	√	√			√	√	
						10	400	√	√			√	√	
						11	300	√	√			√	√	
						12	10	√	√	√				
06.11. 2006	#5, 01	3689	29º10’	18º00’	2000									
						1	200	√	√	√	√	√	√	
						2	150	√	√		√	√	√	
						3	125	√	√		√	√	√	
						4	100	√	√		√	√	√	
						5	75	√	√		√	√	√	
						6	50	√	√		√	√	√	
						7	25	√	√		√	√	√	

						8	10	√	√	√	√	√	√	
						9	10							
						10	10							
						11	10							
						12	10							
Date Time (hh:mm	**St. #, CTD Cast**	**Depth sta,m**	**Lat. N**	**Long. W**	**Depth Ro,db**	**Nisk bot.**	**Depth samp, db**	**PARAMETERS**						
								O	**N**	**S**	**C**	**A**	**PH**	**Inc**
07.11. 2006	#6, 01	4198	29º10’	18º30’	4000									
						1	4000	√	√	√		√	√	
						2	3500	√	√			√	√	
						3	3000	√	√			√	√	
						4	2500	√	√			√	√	
						5	2000	√	√			√	√	
						6	1800	√	√			√	√	
						7	1500	√	√			√	√	
						8	1300	√	√	√		√	√	
						9	1200	√	√			√	√	
						10	1100	√	√			√	√	
						11	1000	√	√			√	√	
						12	800	√	√	√		√	√	
07.11. 2006	#6, 01	4198	29º10’	18º30’	200									
						1	800	√	√			√	√	
						2	600	√	√			√	√	
						3	400	√	√			√	√	
						4	300	√	√	√		√	√	
						5	200	√	√	√	√	√	√	
						6	150	√	√		√	√	√	
						7	125	√	√		√	√	√	
						8	100	√	√		√	√	√	
						9	75	√	√		√	√	√	
						10	50	√	√		√	√	√	
						11	25	√	√		√	√	√	
						12	10	√	√	√	√	√	√	
Date Time (hh:mm	**St. #, CTD Cast**	**Depth sta,m**	**Lat. N**	**Long. W**	**Depth Ro,db**	**Nisk bot.**	**Depth samp, db**	**PARAMETERS**						
								O	**N**	**S**	**C**	**A**	**PH**	**Inc**
07.11. 2006	# 7, 01	4046	28º30’	18º30’	2000									
						1	2000	√	√	√		√	√	
						2	1800	√	√			√	√	
						3	1500	√	√			√	√	
						4	1300	√	√			√	√	
						5	1200	√	√			√	√	
						6	1100	√	√			√	√	
						7	1000	√	√			√	√	
						8	800	√	√	√		√	√	
						9	600	√	√			√	√	
						10	400	√	√			√	√	
						11	300	√	√	√		√	√	
						12	10	√	√			√	√	
07.11. 2006	# 7, 02	4046	28º30’	18º30’	200									
						1	200	√	√	√	√	√	√	
						2	150	√	√		√	√	√	
						3	125	√	√		√	√	√	
						4	100	√	√		√	√	√	

						5	75	√	√		√	√	√	
						6	50	√	√		√	√	√	
						7	25	√	√		√	√	√	
						8	10	√	√	√	√	√	√	
						9	10							
						10	10							
						11	10							
						12	10							
08.11. 2006	# 8, 01	3852	27º47’	18º30’	3800									
						1	3800	√	√	√		√	√	
						2	3500	√	√			√	√	
						3	3000	√	√			√	√	
						4	2500	√	√			√	√	
						5	2000	√	√			√	√	
						6	1800	√	√			√	√	
						7	1500	√	√			√	√	
						8	1300	√	√	√		√	√	
						9	1200	√	√			√	√	
						10	1100	√	√			√	√	
						11	1000	√	√			√	√	
						12	225	√	√	√		√	√	
08.11. 2006	# 8, 02	3852	27º47’	18º30’	800									
						1	800	√	√	√		√	√	
						2	600	√	√					
						3	400	√	√					
						4	300	√	√					
						5	200	√	√		√	√	√	
						6	150	√	√		√	√	√	
						7	125	√	√		√	√	√	
						8	100	√	√	√	√	√	√	
						9	75	√	√		√	√	√	
						10	50	√	√		√	√	√	
						11	25	√	√		√	√	√	
						12	10	√	√	√	√	√	√	
Date Time (hh:mm	**St. #, CTD Cast**	**Depth sta,m**	**Lat. N**	**Long. W**	**Depth Ro,db**	**Nisk bot.**	**Depth samp, db**	**PARAMETERS** O	N	S	C	A	PH	Inc
08.11. 2006	# 9, 01	3345	28º00’	18º12’	2000									
						1	2000	√	√	√		√	√	
						2	1800	√	√			√	√	
						3	1500	√	√			√	√	
						4	1300	√	√			√	√	
						5	1200	√	√			√	√	
						6	1100	√	√			√	√	
						7	1000	√	√			√	√	
						8	800	√	√	√		√	√	
						9	600	√	√			√	√	
						10	400	√	√			√	√	
						11	300	√	√	√		√	√	
						12	10	√	√			√	√	
08.11. 2006	# 9, 02	3345	28º00’	18º12’	200									
						1	200	√	√	√	√	√	√	
						2	150	√	√		√	√	√	
						3	125	√	√		√	√	√	
						4	100	√	√		√	√	√	

						5	75	√	√		√	√	√	
						6	50	√	√		√	√	√	
						7	25	√	√		√	√	√	
						8	10	√	√	√	√	√	√	
						9	10							
						10	10							
						11	10							
						12	10							
09.11. 2006	# 10, 01	2999	28º15’	17º47’	2000									
						1	2000	√	√	√		√	√	
						2	1800	√	√			√	√	
						3	1500	√	√			√	√	
						4	1300	√	√			√	√	
						5	1200	√	√			√	√	
						6	1100	√	√			√	√	
						7	1000	√	√			√	√	
						8	800	√	√	√		√	√	
						9	600	√	√			√	√	
						10	400	√	√			√	√	
						11	300	√	√	√		√	√	
						12	10	√	√			√	√	
09.11. 2006	# 10, 02	2999	28º15’	17º47’	200									
						1	200	√	√	√	√	√	√	
						2	150	√	√		√	√	√	
						3	125	√	√		√	√	√	
						4	100	√	√		√	√	√	
						5	75	√	√		√	√	√	
						6	50	√	√		√	√	√	
						7	25	√	√		√	√	√	
						8	10	√	√	√	√	√	√	
						9	10							
						10	10							
						11	10							
						12	0				√			
Date Time (hh:mm	**St. #, CTD Cast**	**Depth sta,m**	**Lat. N**	**Long. W**	**Depth Ro,db**	**Nisk bot.**	**Depth samp, db**	**PARAMETERS** O	N	S	C	A	PH	Inc
09.11. 2006	# 11, 01	2844	28º28’	17º25’	2000									
						1	2000	√	√	√		√	√	
						2	1800	√	√			√	√	
						3	1500	√	√			√	√	
						4	1300	√	√			√	√	
						5	1200	√	√			√	√	
						6	1100	√	√			√	√	
						7	1000	√	√			√	√	
						8	800	√	√	√		√	√	
						9	600	√	√			√	√	
						10	400	√	√			√	√	
						11	300	√	√			√	√	
						12	10	√	√	√		√	√	
09.11. 2006	# 11, 02	2844	28º28’	17º25’	200									
						1	200	√	√	√	√	√	√	
						2	150	√	√		√	√	√	
						3	125	√	√		√	√	√	
						4	100	√	√		√	√	√	

						5	75	√	√		√	√	√	
						6	50	√	√		√	√	√	
						7	25	√	√		√	√	√	
						8	10	√	√		√	√	√	
						9	10							
						10	10							
						11	10							
						12	0	√	√	√	√	√	√	
09.11. 2006	# 12, 01	3308	28º42’	17º00’	2000									
						1	2000	√	√	√		√	√	
						2	1800	√	√			√	√	
						3	1500	√	√			√	√	
						4	1300	√	√			√	√	
						5	1200	√	√			√	√	
						6	1100	√	√			√	√	
						7	1000	√	√			√	√	
						8	800	√	√	√		√	√	
						9	600	√	√			√	√	
						10	400	√	√			√	√	
						11	300	√	√			√	√	
						12	10	√	√	√		√	√	
09.11. 2006	# 12, 02	3308	28º42’	17º00’	200									
						1	200	√	√	√	√	√	√	
						2	150	√	√		√	√	√	
						3	125	√	√		√	√	√	
						4	100	√	√		√	√	√	
						5	75	√	√		√	√	√	
						6	50	√	√		√	√	√	
						7	25	√	√		√	√	√	
						8	10	√	√		√	√	√	
						9	10							
						10	10							
						11	10							
						12	0	√	√	√	√	√	√	
10.11. 2006	Mcat Cal.	3621	29º10’	15º57’	300			Test microcats prior to mooring deployment						
10.11. 2006	Cal.	3621	29º10’	15º57’	300			Test cast for chemical pack calibration prior to deployment						
						1	300	√	√	√				
						2	200	√	√		√			
						3	150	√	√		√			
						4	125	√	√		√			
						5	100	√	√		√			
						6	90	√	√		√			
						7	80	√	√		√			
						8	70	√	√		√			
						9	55	√	√		√			
						10	40	√	√		√			
						11	25	√	√		√			
						12	10	√	√	√	√			
Date Time (hh:mm	**St. #, CTD Cast**	**Depth sta,m**	**Lat. N**	**Long. W**	**Depth Ro,db**	**Nisk bot.**	**Depth samp, db**	**PARAMETERS** **O**	**N**	**S**	**C**	**A**	**PH**	**Inc**
10.11. 2006	#14 01	3652	29º10’	16º11’	3200									
						1	3200	√	√	√		√	√	

						2	3000	√	√			√	√	
						3	2800	√	√			√	√	
						4	2500	√	√			√	√	
						5	2000	√	√			√	√	
						6	1800	√	√			√	√	
						7	1500	√	√			√	√	
						8	1300	√	√	√		√	√	
						9	1200	√	√			√	√	
						10	1100	√	√			√	√	
						11	1000	√	√	√		√	√	
						12	225	√	√			√	√	
10.11. 2006	# 14, 02	3652	29º10’	16º11’	800									
						1	800	√	√	√		√	√	
						2	600	√	√			√	√	
						3	400	√	√			√	√	
						4	300	√	√	√		√	√	
						5	200	√	√		√	√	√	
						6	150	√	√		√	√	√	
						7	125	√	√		√	√	√	
						8	100	√	√		√	√	√	
						9	75	√	√		√	√	√	
						10	50	√	√		√	√	√	
						11	25	√	√		√	√	√	
						12	10	√	√	√	√	√	√	
11.11. 2006	# 2, 01	3308	29º10’	16º30’	2000									
						1	2000	√	√	√		√	√	
						2	1800	√	√			√	√	
						3	1500	√	√			√	√	
						4	1300	√	√			√	√	
						5	1200	√	√			√	√	
						6	1100	√	√			√	√	
						7	1000	√	√			√	√	
						8	800	√	√	√		√	√	
						9	600	√	√			√	√	
						10	400	√	√			√	√	
						11	300	√	√			√	√	
						12	10	√	√	√		√	√	
11.11. 2006	# 2, 02	3308	29º10’	16º30’	200									
						1	200	√	√	√	√	√	√	
						2	150	√	√		√	√	√	
						3	125	√	√		√	√	√	
						4	100	√	√		√	√	√	
						5	75	√	√		√	√	√	
						6	50	√	√		√	√	√	
						7	25	√	√		√	√	√	
						8	10	√	√		√	√	√	
						9	10							
						10	10							
						11	10							
						12	0	√	√	√	√	√	√	
Date Time (hh:mm	**St. #, CTD Cast**	**Depth sta,m**	**Lat. N**	**Long. W**	**Depth Ro,db**	**Nisk bot.**	**Depth samp, db**	**PARAMETERS O**	**N**	**S**	**C**	**A**	**PH**	**Inc**
11.11. 2006	# 13, 01	3308	29º10’	16º30’	2000									
						1	2000	√	√	√		√	√	

						2	1800	√	√			√	√	
						3	1500	√	√			√	√	
						4	1300	√	√			√	√	
						5	1200	√	√			√	√	
						6	1100	√	√			√	√	
						7	1000	√	√			√	√	
						8	800	√	√			√	√	
						9	600	√	√			√	√	
						10	400	√	√			√	√	
						11	300	√	√			√	√	
						12	10	√	√	√		√	√	
11.11. 2006	# 13, 01	3308	29º10’	16º30’	200									
						1	200	√	√	√	√	√	√	
						2	150	√	√		√	√	√	
						3	125	√	√		√	√	√	
						4	100	√	√		√	√	√	
						5	75	√	√		√	√	√	
						6	50	√	√		√	√	√	
						7	25	√	√		√	√	√	
						8	10	√	√		√	√	√	
						9	10							
						10	10							
						11	10							
						12	0	√	√	√	√	√	√	
11.11. 2006	Cal.	3621	29º10’	16º30’	85			Test cast for nutrient calibration of sensor prototype.						
						1	85		√					
						2	80		√					
						3	70		√					
						4	60		√					
						5	50		√					
						6	50		√					
						7	40		√					
						8	30		√					
						9	20		√					
						10	20		√					
						11	10		√					
						12	0		√					
Date Time (hh:mm	**St. #, CTD Cast**	**Depth sta,m**	**Lat. N**	**Long. W**	**Depth Ro,db**	**Nisk bot.**	**Depth samp, db**	**PARAMETERS** **O**	**N**	**S**	**C**	**A**	**PH**	**Inc**
12.11. 2006	ES11 01	3608	29º10’	15º20’	3500									
						1	3500	√	√	√		√	√	
						2	3000	√	√	√		√	√	
						3	2800	√	√	√		√	√	
						4	2500	√	√	√		√	√	
						5	2000	√	√	√		√	√	
						6	1800	√	√	√		√	√	
						7	1500	√	√	√		√	√	
						8	1300	√	√	√		√	√	
						9	1200	√	√	√		√	√	
						10	1100	√	√	√		√	√	
						11	1000	√	√	√		√	√	
						12	800	√	√			√	√	
12.11. 2006	ES11 02	3608	29º10’	15º20’	800									
						1	800	√	√	√		√	√	

						2	600	√	√	√		√	√	
						3	400	√	√	√		√	√	
						4	300	√	√	√		√	√	
						5	200	√	√	√	√	√	√	
						6	150	√	√	√	√	√	√	
						7	125	√	√	√	√	√	√	
						8	100	√	√	√	√	√	√	
						9	75	√	√	√	√	√	√	
						10	50	√	√	√	√	√	√	
						11	25	√	√	√	√	√	√	
						12	10	√	√	√	√	√	√	

8.3 Methods

8.3.1 Water Sampling

Samples were collected immediately after the Niskin bottles were on board from each depth. The sampling sequence was as follows:

1.) Oxygen: was taken in glass bottles of about 125 ml of volume which were previously cleaned and washed with HCl acid and was fixed at once; then it was kept for at least six hours according to WOCE regulations and finally it was analysed at the laboratory on board the ship.
2.) Carbon system measurements: in this case pH and alkalinity: samples were taken in glass bottles and were fixed immediately on board.
2.) Nutrients: were taken in polypropylene bottles which were previously cleaned and washed with HCl acid and were completely dry. Samples were immediately frozen at -20°C, analysing them as soon as possible after arrival at the laboratory. Freezing the samples is a common practice; it does not or only in a non-significant way affect the nitrate+nitrite and the phosphate values (by a slight decrease) and is not noticeable in the silicate values (Kremling and Wenck,1986; McDonald and McLunghlin, 1982).
3.) Salinity: samples were taken in dark glass bottles which were previously cleaned and washed with HCl acid. Then, they were kept in boxes to protect them from light till analysis on land.
4.) Chlorophyll: samples of one liter of water were taken. The chlorophyll samples were filtered inmediatelly and the filters were frozen subsequently at -20°C. Their analyses takes place at the ICCM laboratory in land.

All samples were taken using the procedures established in the WOCE Operations Manual, WHP Office Report WHPO 91-1/WOCE Report No.68/91.

8.3.2 Analysis

Dissolved Oxygen

The samples were analysed using the method described in the WOCE Operations Manual, WHP Office Report No. 68/91; the final titration point was detected using a Metrohm 782 Dosimat Oxygen Auto-Titrator Analyser.

Carbonate system measurements

The pHt in total scale (mol (kg-SW)-1) was measured following the spectrophotometric technique of Clayton and Byrne (1993) using the m-cresol purple indicator (DOE, 1994). 0.0047 pH units were added to the pH experimental values in order to take into consideration the recommendations by Lee et al. (2000). A system similar to that described by Bellerby et al. (1995) was developed in our lab. The pHt measurements were carried out using a Hewlett Packard Diode Array spectrophotometer in a 25ºC-thermostated 1-cm flow-cell using a Peltier system. A stopped-flow protocol was used to analyse seawater previously thermostated to 25ºC for a blank determination at 730, 578 and 434 nm. The flow was restarted, and the indicator injection valve switched on to inject

10 µl dye through a mixing coil (2 m). Three photometric measurements were carried out for each injection in order to remove all dye effect on the seawater pHt measurement. Repeatedly, seawater measurements of the different Certified Reference Materials (CRM provided by Dr. Dickson, Scripps Institution of Oceanography) samples gave a standard deviation of ± 0.0015 (n = 54).

The total alkalinity of seawater (A_T) was determined by titration with HCl to the carbonic acid end point using two similar potentiometric systems, as described in more detail by Mintrop et al. (2000). In order to yield an ionic strength similar to open ocean seawater, the HCl solution (25 l, 0.25 M) was made from concentrated analytical grade HCl (Merck®, Darmstadt, Germany) in 0.45 M NaCl. The acid was standardised by titrating weighed amounts of Na_2CO_3 dissolved in 0.7 M NaCl solutions. The total alkalinity of seawater was evaluated from the proton balance at the alkalinity equivalence point, $pH_{equiv} = 4.5$, according to the exact definition of total alkalinity (Dickson, 1981). The performance of the titration systems was monitored by titrating different samples of certified reference material (CRM, batch 42) with known inorganic carbon and A_T values. The agreement between our data and CRM values was within ±1.5 µmol kg^{-1}. Total inorganic carbon (C_T) is computed from experimental values of pH_t and total alkalinity, using the carbonic acid dissociation constants of Mehrbach after Dickson and Millero (1987). This set of constants presented the best agreement between C_T(pH, A_T) calculations and certified C_T values for CRM, batch 42, with a C_T residual of ± 3 µmol kg^{-1}, n=54 (Millero, 1995, Lee et al., 1997).

Nutrients

The nutrients determination was performed with a segmented continuous-flow autoanalyser, a Skalar® San Plus System (ICCM).

Nitrate+Nitrite: The automated procedure for the determination of nitrate and nitrite is based on the cadmium reduction method; the sample is passed through a column containing granulated copper-cadmium to reduce the nitrate to nitrite (Wood et al.,1967), using ammonium chloride as pH controller and complexer of the cadmium cations formed (Strickland and Parsons, 1972). The optimal column preparation conditions are described by several authors (Nydahl, 1976; Garside**,** 1993).

Phosphate: Orthophosphate concentration is understood as the concentration of reactive phosphate (Riley and Skirpow,1975) and according to Koroleff (1983a) is a synonym of "dissolved inorganic phosphate". The automated procedure for the determination of phosphate is based on the following reaction: ammonium molybdate and potassium antimony tartrate react in an acidic medium with diluted solution of phosphate to form an antimony-phospho-molybdate complex. This complex is reduced to an intensely blue-coloured complex, ascorbic acid. The complex is measured at 880nm. The basic methodology for this anion determination is given by Murphy and Riley (1962); the used methodology is the one adapted by Strickland and Parsons (1972).

Silicate: The determination of the soluble silicon compounds in natural waters is based on the formation of the yellow coloured silicomolybdic acid; the sample is acidified and mixed with an ammonium molybdate solution forming molybdosilicic acid. This acid is reduced with ascorbic acid to a blue dye, which is measured at 810nm. Oxalic acid is added to avoid phosphate interference. The used method is described in Koroleff (1983b).

Phytoplankton pigments

Pigments were measured using fluorimetric analysis, following the methodology described by Welschmeyer (1994). The determination was achieved using a fluorometer TURNER 10-AU-000.

Salinity

Samples were measured with a salinometer, model Autosal 8400a, whose measurement range was between 0.005-42 (psu), with an accuracy of ±0.003, according to the manufacturer. It was calibrated following the manufacturer´s information and standarizing it with IAPSO Standard Seawater. Salinity values were calculated as practical salinity according to Unesco (1978, 1984).

8.4 Preliminary Results

This cruise took place at the beginning of November, which corresponds in surface waters and for this northeast Atlantic subtropical marine area to the time of the year when the seasonal thermocline -that was formed last summer- is already formed across the survey area (Fig. 2 A). This layer was founded between 50 to 75 m and temperature vertical gradients near 0.1 ºC m^{-1} were observed. Below the seasonal thermocline (Fig. 2 B), the temperature decreased to the bottom and reduced sequentially the temperature gradients (lower than 0.02 ºC m^{-1} below 200 m). A higher temperature variability is noticeable around 1000 m depth due to the presence of intermediate waters (AAIW and MOW- Mediterranean Outflow Water).

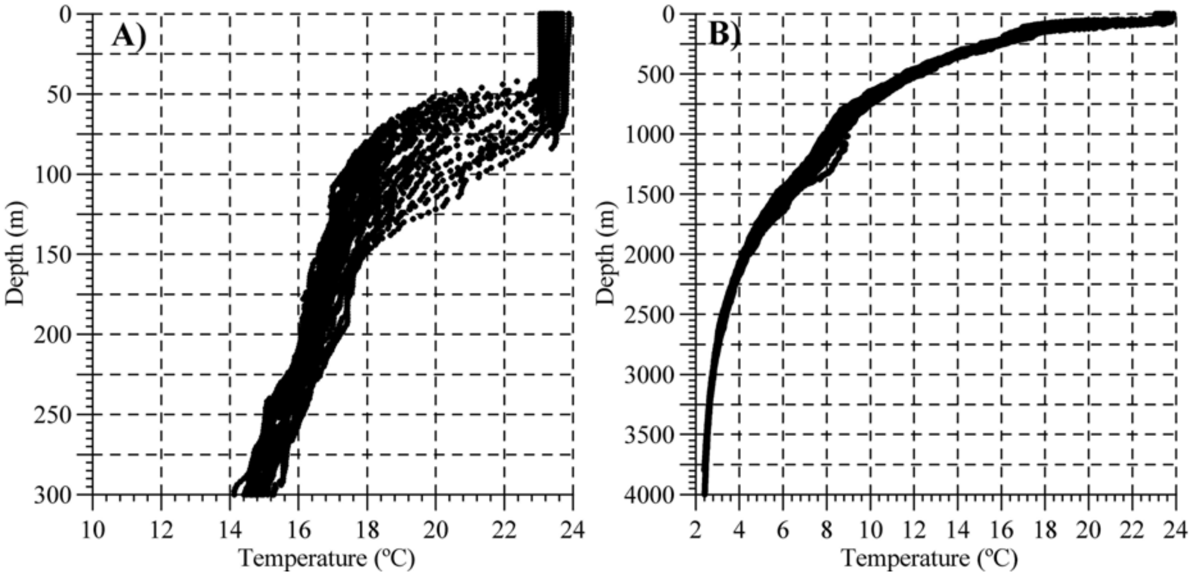


Fig. 12: Temperature (ºC) versus depth (m) (A). Zoom from surface to 300 m (B) The entire water column.

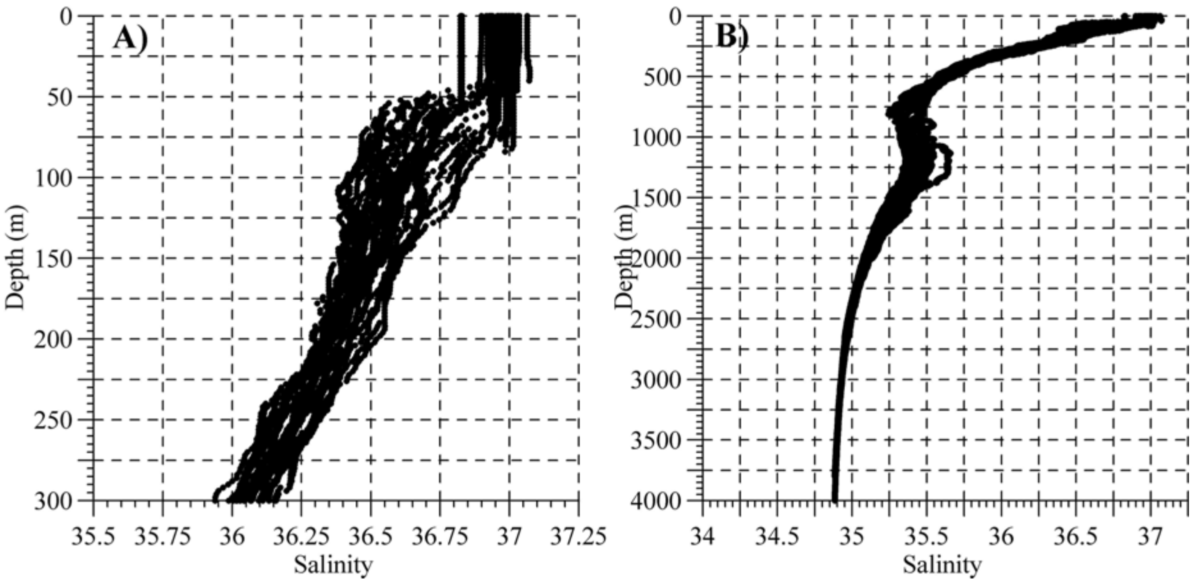


Fig. 13: Salinity versus depth (m) (A). Zoom from surface to 300 m (B) The entire water column.

Salinity profiles presented (Fig. 3) similar aspects than temperature profiles. A seasonal halocline is observed between 50 to 75 m with vertical gradients near 0.01 of salinity m^{-1} (Fig. 3 A) whereas it is reduced to values lower than 0.004 below 200 m depth. Salinity surface values were around 37 which are typical for this season and a higher variability was observed below 1000m depth due to intermediates waters, as it was mentioned above (Fig. 3 B). A performance of TS diagram shows the water masses present in the survey area (Fig. 4). Thus, North Atlantic Central Water (NACW) is visible as a almost straight line between 10º to 18º C, the intermediate waters (AAIW and MOW) take place between 6º to 9º C and the scatters move to lower or higher salinities due to its percentage in the mixing , respectively. The limit value to have a small amount of MOW in this area is a salinity of 35.5 (Llinás et al., 2002). Finally, we found the North Atlantic Deep Water (NADW) as a straight line ranged between 6º and 2.5ºC.

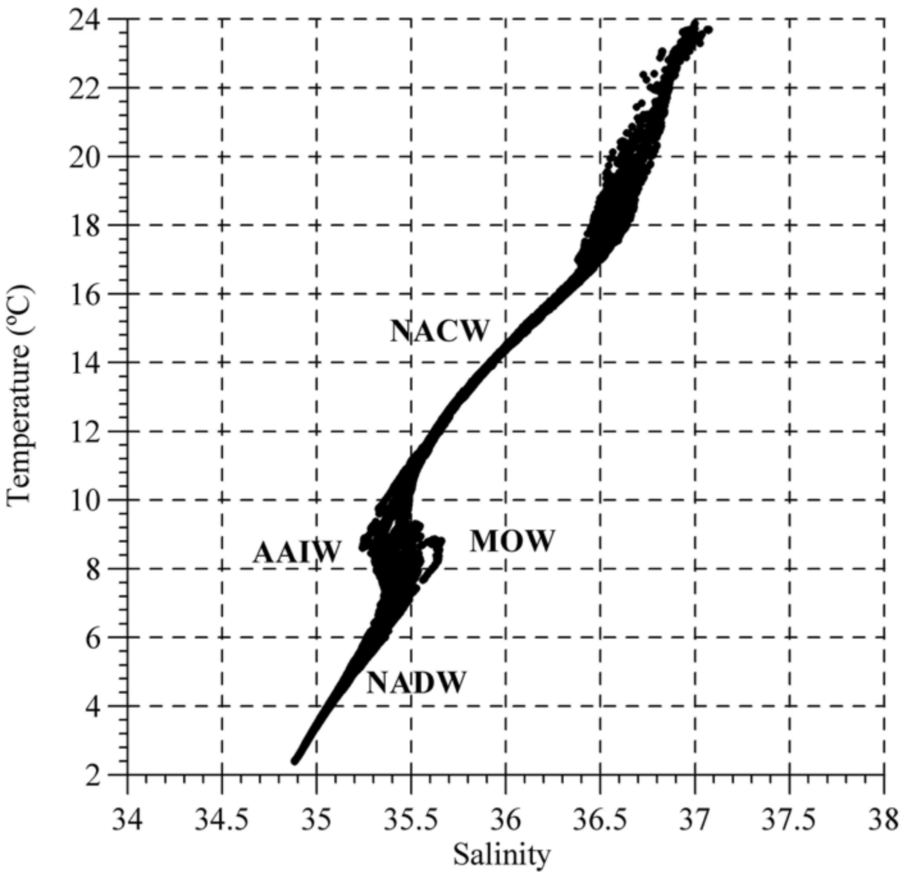


Fig. 14: Salinity versus Temperature (ºC) (A). Water masses present in the area.

The oxygen measured during P344_2 down to bottom (Figure 5 A), we can note a oxygen minima near 800 m what is typical in this area. However, the values of these minima swing from 3.05 to 3.8 ml/l and pointed out the presence of AAIW in the stations where the lower values were observed. Also, some relative oxygen minima were measured at the surface. These surface minima were consequence of the biological consum and the ausence of mixing due to the presence of seasonal thermocline. In order to localize the stations where AAIW was present we plotted the oxygen versus temperatures (Fig. 5 B). The oxygen minima, attributed to this water mass in the area, were measued at the southern stations as expected (St. 8 to 11, purple). However, the absolute oxygen minimum was measured at the station 14 (red) in the 29º N transect whereas the stations 12 and 13 (green) situated in the passage showed higher oxygen values as well as the other stations in the 29º N track way (black). These differences show the oxygen variations due to the mixing across the archipelago.

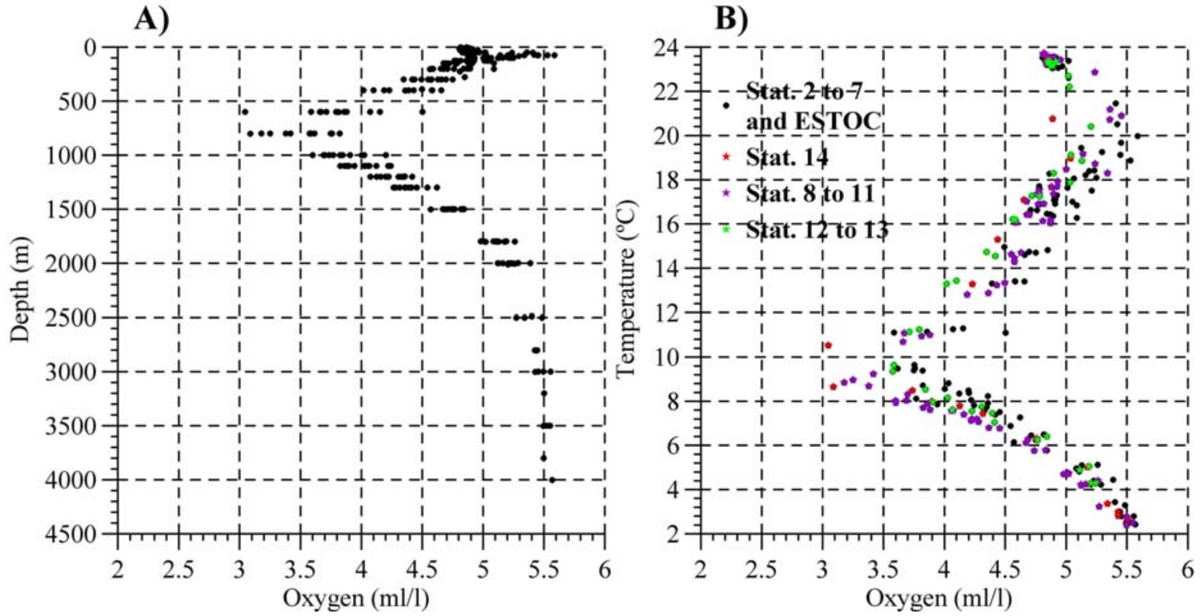


Fig. 15: (A) Oxygen profiles. (B) Oxygen versus temperature diagram. Some stations are highlighted at different colors.

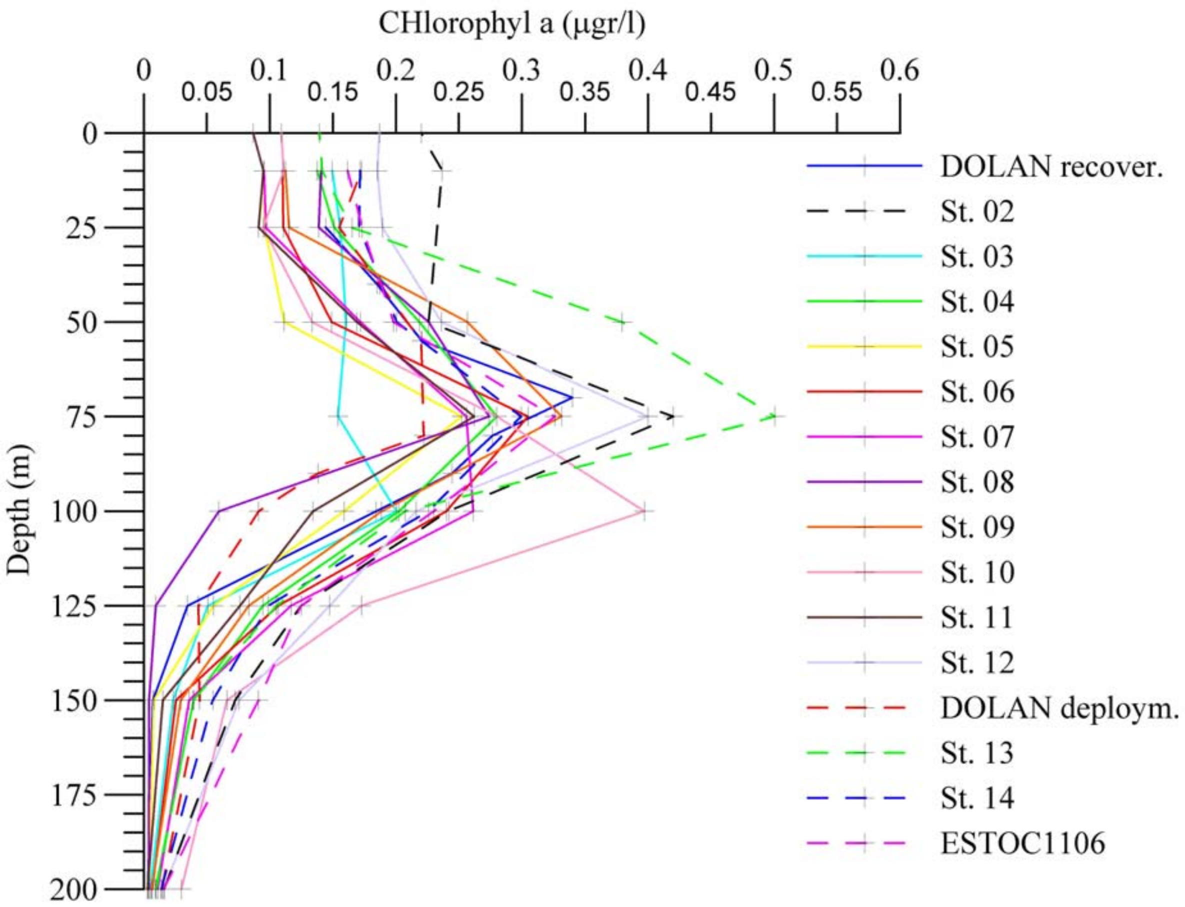


Fig.16: Chlorophyl a (µg/l) profiles down to 200m along P344_2.

Values for chlorophyl a ranged between 0 and 0.5 µg/l along P344_2 for all the stations. The maxima were mainly located at 75 m depth and these were absolute northwards Tenerife Island. These chlorophyl a maxima correspond with the Deep Chlorophyl Maximum (DCM). It has been defined as a quasi-permanent feature of all subtropical gyres, is present during summer and fall and located below the seasonal thermocline and above the nitracline and linked to a wide range of isopycnals.

9. References

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10. List of stations

Stat. No.	Date	Time	Description	Latitude			Longitude			Waterdepth
903	04.11.2006	16:10	Recovery DOLAN buoy	29°	10,48'	N	015°	56,25'	W	3628,0
		18:40	Station completed	29°	10,46'	N	015°	56,06'	W	3627,0
904	04.11.2006	19:00	Ship @ Station	29°	10,80'	N	015°	55,26'	W	3627,0
		19:11	CTD/Ro t/water	29°	10,79'	N	015°	55,25'	W	3626,0
		19:34	Station completed	29°	10,66'	N	015°	55,10'	W	3627,0
905	04.11.2006	23:00	Ship @ Station	29°	09,97'	N	015°	20,00'	W	3596,0
		23:02	Turtle t/water	29°	09,96'	N	015°	19,99'	W	3695,0
905-2		23:06	1. NOAA-drifter t/water	29°	09,96'	N	015°	20,00'	W	3695,0
905-3		23:06	2. NOAA-drifter t/water	29°	09,96'	N	015°	20,00'	W	3695,0
905-4		23:06	3. NOAA-drifter t/water	29°	09,96'	N	015°	20,00'	W	3596,0
905-5		23:14	XBT # 1 t/water	29°	09,97'	N	015°	19,89'	W	3596,0
		23:17	Station completed	29°	09,58'	N	015°	19,88'	W	3596,0
906	06.11.2006	05:56	Ship @ Station	29°	10,08'	N	017°	00,06'	W	3882,0
		06:06	CTD/Ro t/water	29°	10,06'	N	017°	00,09'	W	3882,0
906-2		08:01	CTD/Ro t/water	29°	10,01'	N	017°	00,06'	W	3882,0
		08:24	Station completed	29°	10,01'	N	017°	00,04'	W	3882,0
907	06.11.2006	12:00	Ship @ Station	29°	10,01'	N	017°	30,00'	W	3854,0
		12:04	CTD/Ro t/water	29°	10,02'	N	017°	30,00'	W	3850,0
907-2		14:04	CTD/Ro t/water	29°	10,04'	N	017°	30,04'	W	3851,0
		14:25	Station completed	29°	10,05'	N	017°	30,01'	W	3851,0
908	06.11.2006	18:11	Ship @ Station	29°	10,01'	N	017°	59,98'	W	3690,0
		18:17	CTD/Ro t/water	29°	10,04'	N	017°	59,95'	W	3690,0
908-2		20:21	CTD/Ro t/water	29°	10,02'	N	017°	59,99'	W	3690,0
		20:40	Station completed	29°	10,02'	N	017°	59,98'	W	3691,0
909	07.11.2006	05:56	Ship @ Station	29°	09,99'	N	018°	29,96'	W	4197,0
		06:58	CTD/Ro t/water	29°	09,98'	N	018°	29,93'	W	4197,0
909-2		10:34	CTD/Ro t/water	29°	10,02'	N	018°	30,03'	W	4198,0
		11:19	CTD/Ro @ deck	29°	10,01'	N	018°	30,03'	W	4198,0
909-3		12:09	CTD/Ro t/water	29°	10,00'	N	018°	29,99'	W	4198,0
		14:50	Station completed	29°	09,99'	N	018°	29,99'	W	4199,0
910	07.11.2006	19:12	Ship @ Station	28°	30,00'	N	018°	29,99'	W	4047,0
		19:17	CTD/Ro t/water	28°	29,97'	N	018°	29,99'	W	4046,0
		20:47	CTD/Ro @ deck	28°	29,50'	N	018°	29,93'	W	4036,0
910-2		21:24	CTD/Ro t/water	28°	30,02'	N	018°	30,06'	W	4048,0
		21:42	Station completed	28°	29,98'	N	018°	30,01'	W	4048,0
911	08.11.2006	07:46	Ship @ Station	27°	46,98'	N	018°	30,02'	W	3853,0
		08:08	CTD/Ro t/water	27°	46,97'	N	018°	30,03'	W	3852,0
		08:50	CTD/Ro @ deck	27°	46,99'	N	018°	30,01'	W	3852,0
911-2		09:35	CTD/Ro t/water	27°	46,97'	N	018°	29,99'	W	3852,0
		11:57	Station completed	27°	46,98'	N	018°	30,01'	W	3852,0
912	08.11.2006	16:33	Ship @ Station	28°	00,02'	N	018°	11,99'	W	3347,0
		16:37	CTD/Ro t/water	28°	00,04'	N	018°	11,98'	W	3347,0
		17:53	CTD/Ro @ deck	28°	00,04'	N	018°	11,62'	W	3344,0
912-2		18:41	CTD/Ro t/water	28°	00,22'	N	018°	11,71'	W	3353,0
		19:24	Station completed	28°	00,27'	N	018°	11,42'	W	3337,0
913	09.11.2006	05:55	Ship @ Station	28°	15,00'	N	017°	47,04'	W	2999,0
		06:04	CTD/Ro t/water	28°	15,00'	N	017°	47,05'	W	2999,0
		07:24	CTD/Ro @ deck	28°	14,94'	N	017°	46,99'	W	2999,0
913-2		08:13	CTD/Ro t/water	28°	14,99'	N	017°	47,03'	W	3000,0
		08:34	Station completed	28°	14,98'	N	017°	47,03'	W	2998,0
914	09.11.2006	12:00	Ship @ Station	28°	27,99'	N	017°	24,96'	W	2834,0
		12:18	CTD/Ro t/water	28°	28,01'	N	017°	24,96'	W	2847,0

		13:37	CTD/Ro @ deck	28°	28,19'	N	017°	24,08'	W	2847,0
914-2		14:17	CTD/Ro t/water	28°	28,06'	N	017°	24,95'	W	2847,0
		14:37	Station completed	28°	27,99'	N	017°	24,95'	W	2847,0
915	09.11.2006	18:10	Ship @ Station	28°	42,00'	N	016°	59,79'	W	3307,0
		18:42	CTD/Ro t/water	28°	42,04'	N	016°	59,67'	W	3306,0
		19:58	CTD/Ro @ deck	28°	42,04'	N	016°	59,47'	W	3298,0
915-2		21:15	CTD/Ro t/water	28°	42,02'	N	016°	59,78'	W	3308,0
		21:35	Station completed	28°	42,00'	N	016°	59,74'	W	3306,0
916	10.11.2006	08:00	Ship @ Station	29°	10,21'	N	015°	57,38'	W	3629,0
		08:33	CTD/Ro t/water	29°	10,09'	N	015°	57,37'	W	3628,0
		09:16	Station completed	29°	10,04'	N	015°	57,31'	W	3627,0
917	10.11.2006	09:46	Ship @ Station	29°	10,16'	N	015°	57,17'	W	3628,0
		09:46	CTD/Ro t/water	29°	10,16'	N	015°	57,17'	W	3628,0
		10:16	Station completed	29°	10,03'	N	015°	57,16'	W	3628,0
918	10.11.2006	12:57	Station DOLAN-SBU	29°	09,58'	N	015°	58,23'	W	3628,0
		15:52	DOLAN-SBU t/Water	29°	10,25'	N	015°	56,58'	W	3628,0
		16:27	Station completed	29°	10,07'	N	015°	56,64'	W	3628,0
919	10.11.2006	18:15	Ship @ Station	29°	10,03'	N	016°	11,45'	W	3654,0
		18:21	CTD/Ro t/water	29°	10,02'	N	016°	11,40'	W	3654,0
		19:04	CTD/Ro @ deck	29°	10,00'	N	016°	11,40'	W	3654,0
919-2		19:52	CTD/Ro t/water	29°	10,02'	N	016°	11,40'	W	3653,0
		22:22	Station completed	29°	10,01'	N	016°	11,41'	W	3653,0
920	11.11.2006	05:56	Ship @ Station	29°	10,04'	N	016°	30,02'	W	3696,0
		06:01	CTD/Ro t/water	29°	10,06'	N	016°	30,03'	W	3698,0
		07:20	CTD/Ro @ deck	29°	10,03'	N	016°	30,04'	W	3696,0
920-2		08:20	CTD/Ro t/water	29°	10,05'	N	016°	30,00'	W	3686,0
		08:40	CTD/Ro @ deck	29°	10,07'	N	016°	30,09'	W	3695,0
920-3		09:20	CTD/Ro t/water	29°	10,02'	N	016°	30,00'	W	3696,0
		09:39	Station completed	29°	10,05'	N	016°	30,03'	W	3696,0
921	11.11.2006	12:10	Ship @ Station	28°	56,00'	N	016°	35,00'	W	3520,0
		12:11	CTD/Ro t/water	28°	55,96'	N	016°	35,04'	W	3520,0
		12:30	CTD/Ro @ deck	28°	55,88'	N	016°	35,15'	W	3535,0
921-2		14:05	CTD/Ro t/water	28°	55,96'	N	016°	34,98'	W	3518,0
		14:23	Station completed	28°	55,95'	N	016°	34,99'	W	3520,0
922	11.11.2006	22:25	Ship @ Station	29°	10,02'	N	015°	30,85'	W	3608,0
		22:26	CTD/Ro t/water	29°	10,02'	N	015°	30,85'	W	3608,0
		23:05	CTD/Ro @ deck	29°	10,02'	N	015°	30,83'	W	3608,0
922-2	12.11.2006	00:05	CTD/Ro t/water	29°	10,03'	N	015°	30,80'	W	3609,0
		02:01	Station completed	29°	09,91'	N	015°	30,81'	W	3608,0

11. Acknowledgements

All scientific cruise participants thank Captain Michael Schneider and his entire crew for the flexible and friendly assistance during the R/V POSEIDON cruise 344. As on the previous cruises it was a good example of professional support and handling.
The teamwork among the crew and scientists was friendly and relaxed as known from several other cruises on R/V POSEIDON. The cruise could be realized successfully.

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